ENGINEERING CONSTRUCTION WEEKLY

FEB 6 1939

ENGINEERING NEWS-RECORD

FEBRUARY 2, 1939

THE YEAR IN REVIEW

Annual editorial survey of events and developments in civil engineering and construction during 1938, including statistics of the industry, the 1939 outlook and the status of the nation's major construction projects.

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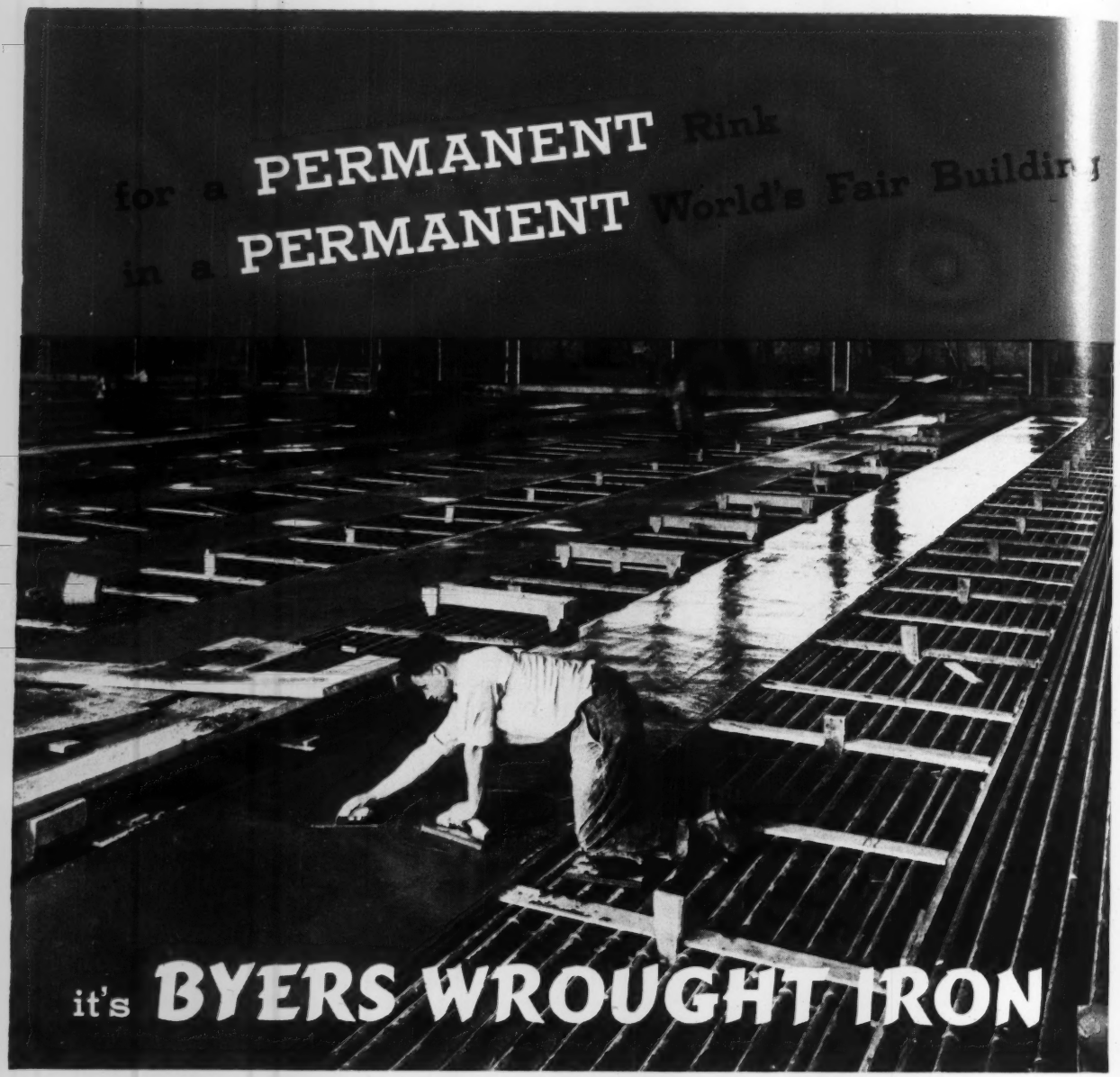

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THINGS TO COME

● Providing earthquake-resistant design for an 18-story building is many times more complicated than taking care of tremor stresses in low structures. How the lofty Los Angeles federal court and post office building was designed and built will be told in the next news-technical edition.

● Herkimer, N. Y., a municipality of 10,000, has hit upon the happy arrangement of a 2-in-1 refuse disposal plant in which garbage incineration and sewage disposal complement each other. Sludge digestion gas is fuel for the incinerator, which in turn burns screenings from the sewage and provides hot water heat for the plant buildings. The story of this plant will appear in two weeks.

● Another feature will be a brief account of a Southern Pacific Railroad relocation which was accomplished without disturbing traffic. The track was raised 9 ft. and shifted as much as 65 ft. during the job.

● "Mining Under a Dam" is the intriguing title of an article to appear soon. Two faults which intersect at Seminoe Dam's base contained quantities of crushed granite. In order to clear these seams without holding up dam concreting, galleries giving access to the foundation were provided in the base. Through these the broken material was removed and grouting was done.

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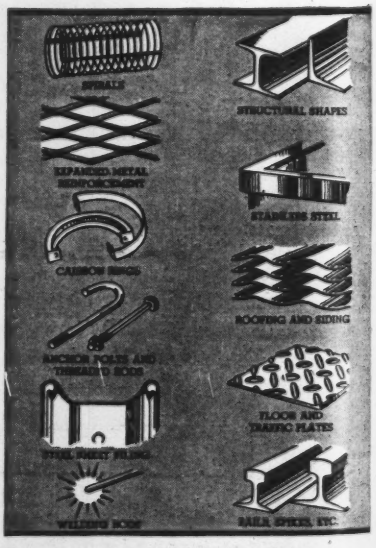

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CONTRACTS AND CAPITAL

ENR CONSTRUCTION VOLUME AND NEW CAPITAL . . . FHA MORTGAGES

(,000 omitted)	January 1938 (4 wks.)	January 1939 (4 wks.)	% Change	December 1938 (5 wks.)	January 1939 (4 wks.)	% Change‡
Total Construction Volume	$190,186	$311,693	+64.0	$339,250	$311,693	+15.0
Private	79,467	51,291	−35.5	59,657	51,291	+ 7.5
Public	110,719	260,402	+136.0	279,593	260,402	+16.5
Federal	12,912	31,352	+142.0	39,389	31,352	− 1.0
Total New Productive Capital	$44,399	$69,550	+57.0	$144,155	$69,550	−40.0
Private Investment	41,258	61,512	+49.0	185,667	61,512	−59.0
Federal (non-federal work)	3,141	8,038	+156.0	−41,512†	8,038	.....
FHA Mortgages Selected for Appraisal	$29,904	$67,426*	+126.0	$76,895	$67,426*	−12.0

* Preliminary. † Adjusted for revisions in PWA allotments. ‡ Based on average weekly volume.

CONSTRUCTION COSTS . . . WAGE RATES . . . PRICES

	February 1938	February 1939	% Change	Change January to February 1938 Jan.	1938 Feb.	1938 %	1939 Jan.	1939 Feb.	1939 %
ENR Construction Cost Index, 1913 = 100	238.99	234.31	−2.0	239.62	238.99	−0.3	234.72	234.31	−0.2
ENR Building Cost Index, 1913 = 100	198.99	196.23	−1.4	198.62	198.99	+0.2	196.24	196.23	0
ENR 20-CITIES' AVERAGE									
Common Labor	$0.675	$0.680	+0.7	$0.680	$0.675	−0.7	$0.682	$0.680	−0.3
Skilled Labor (Av. 3 trades)	1.391	1.432	+2.9	1.391	1.391	0	1.432	1.432	0
Bricklayers	1.480	1.514	+2.3	1.480	1.480	0	1.514	1.514	0
Structural Ironworkers	1.442	1.494	+3.6	1.442	1.442	0	1.494	1.494	0
Carpenters	1.251	1.288	+3.0	1.251	1.251	0	1.288	1.288	0
Cement, per bbl.	$2.54	$2.58	+1.6	$2.58	$2.54	+0.4	$2.57	$2.58	+0.4
Reinforcing Steel, cwt.	2.91	2.48	−14.8	2.91	2.91	0	2.48	2.48	0
Struct. Steel Shapes, Pitts.	2.35	2.10	−6.7	2.25	2.25	0	2.10	2.10	0
Sand, per ton	1.25	1.26	+0.8	1.24	1.25	+0.8	1.25	1.26	+0.8
Lumber, 2x4 Fir, per M ft.	34.49	32.38	−6.1	34.74	34.49	−0.7	32.47	32.38	−0.3
Lumber, 2x4 Pine, per M ft.	29.09	29.15	+0.2	29.24	29.09	−0.5	29.09	29.15	+0.2
Brick, common, per M	14.24	14.00	−1.7	14.16	14.24	+0.6	14.03	14.00	−0.2
Ready-Mixed Concrete, c.y.	7.39	7.18	−2.8	7.39	7.39	0	7.18	7.18	0
Struct. Clay Tile, 3x12x12	74.55	74.48	−0.1	72.71	74.55	+2.5	74.48	74.48	0
Paving Asphalt, cars, ton	16.84	13.75	−18.3	16.98	16.84	−0.8	13.92	13.75	−1.2

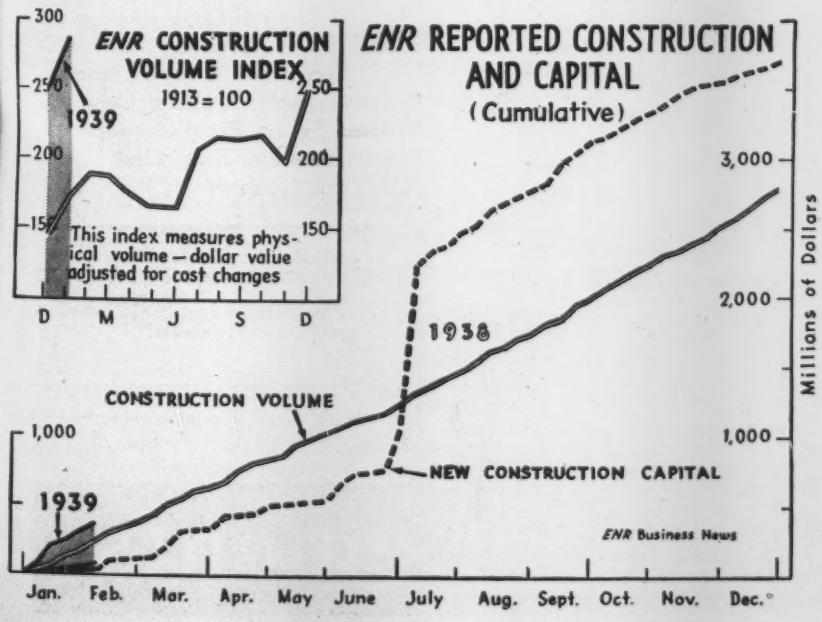
MATERIAL SHIPMENTS . . . BUILDING PERMITS

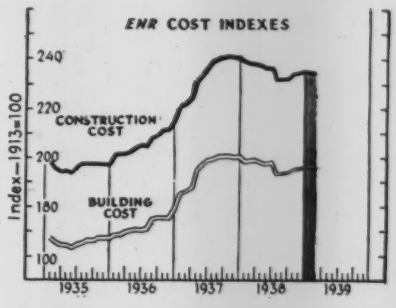
	January 1938	January 1939	% Change	Dec. 1938	% Change Dec.-Jan.
Lumber (% 1929 wk. av.) N.L.M.A.	38.0	56.0	+47.4	58.3	−3.9
Steel (% operating capacity) A.I.S.I.	29.0	51.6	+78.2	53.7	−3.9

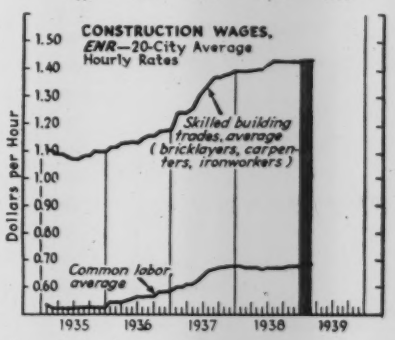
	December 1937	December 1938	% Change	Twelve Months 1937	Twelve Months 1938	% Change
Fabricated Structural Steel (A.I.S.C.) tons	108,396	106,457	−2.0	1,660,570	1,158,763	−30.2
Cement, thous. bbl. (U. S. B. of M.)	4,793	6,281	+31.0	114,010	106,524	−6.4
Building Permits, Dun & Bradstreet, (,000 omitted)	$118,743	$89,582	−24.6	$1,130,915	$1,147,543	+1.5

RENT INDEX . . . EMPLOYMENT

	December 1937	December 1938	% Change	Nov. 1938	% Change Nov.-Dec.
Rent (Housing) Index, N.I.C.B.	88.7	86.2	−2.8	86.4	−0.2
Trade Unions, % Employed, A.F.L.	83.0	85.0	+2.4	84.0	+1.2
Building Trades, % Employed, A.F.L.	64.0	67.0	+4.7	68.0	−1.5






CONSTRUCTION WAGES,
ENR—20-City Average Hourly Rates
Dollars per Hour
Skilled building trades, average (bricklayers, carpenters, ironworkers)
Common labor, average
1935 1936 1937 1938 1939

CONTRACTS

(Thousands of dollars)

	Week Ending Feb. 3 1938	Jan. 26 1939	Feb. 2 1939
Federal	$35,181	$3,978	$3,072
State & Municipal	14,049	32,137	37,791
Total public	$49,230	$36,115	$40,863
Total private	21,578	13,368	18,173
TOTALS	$70,808	$49,483	$59,036
Cumulative 1939 (5 weeks)			$370,729
1938 (5 weeks)			$260,994

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1938 5 Wk.	1939 5 Wk.
NON-FEDERAL	$50,260	$79,755
Corporate securities	11,230	18,645
State & Mun. bonds	35,788	53,072
R.E.A. loans	.....	8,038
R.F.C. loans	2,101	.....
PWA allotments	1,141	.....
FEDERAL	.....	.....
TOTAL CAPITAL	$50,260	$79,755

FHA MORTGAGES

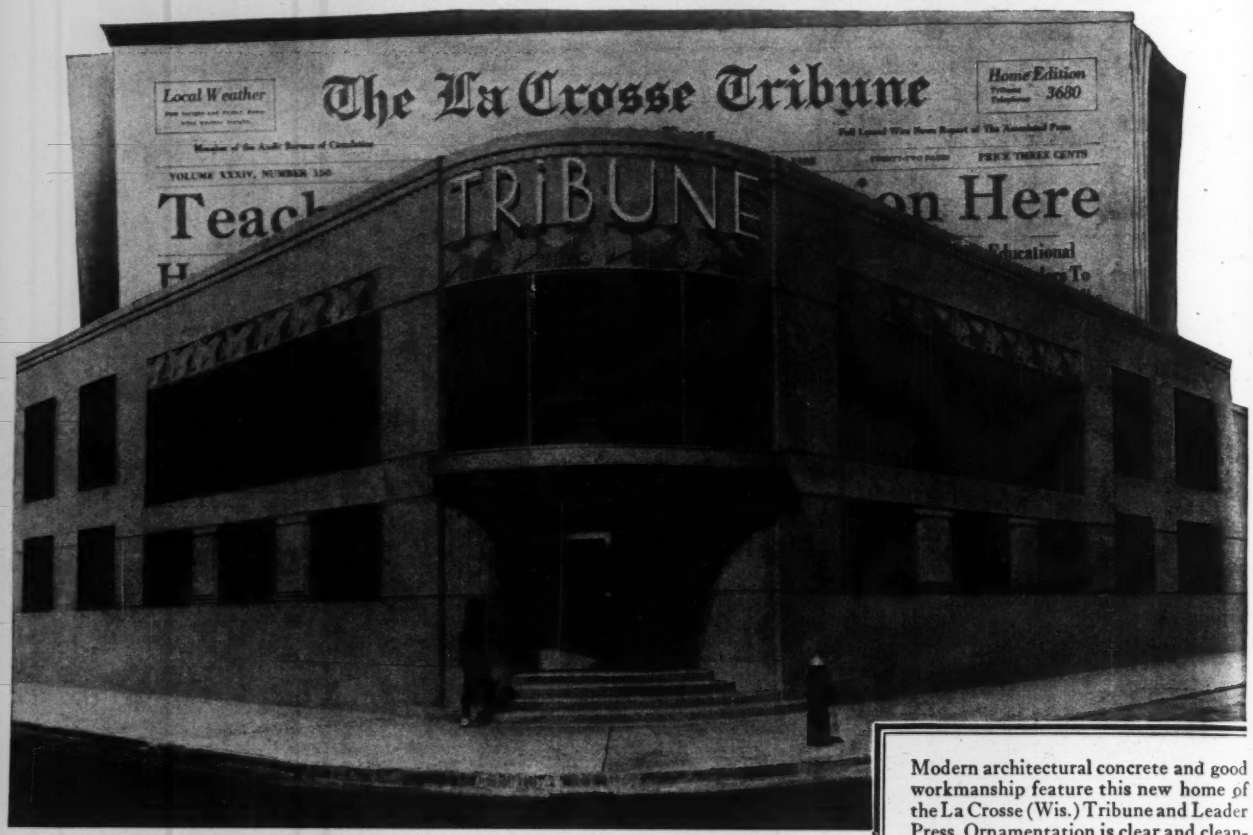
	Week Ending Jan. 29 1938	Jan. 21 1939	Jan. 28 1939
Selected for appraisal	$8,151	$18,270	$19,000*
Cumulative 1939 (4 weeks)			$67,426*
1938 (5 weeks)			$33,309

* Subject to revision.

ENR INDEX NUMBERS

Base = 100	Construction Cost 1913	1926	Building Cost '13	'26	Volume '13	'26
Feb., 1939	234.31	112.63	196.23	106.08	...	...
Jan., 1939	234.72	112.83	196.24	106.08	287	126
Dec., 1938	234.89	112.87	196.07	105.99	249	109
Feb., 1938	238.99	114.85	198.99	107.65	189	83
Jan., 1938	239.62	114.90	198.62	107.30	172	75
1938 (Av.)	235.86	113.34	196.83	106.40	197	86
1937 (Av.)	234.71	112.66	196.15	106.07	172	75
1936 (Av.)	206.42	99.15	172.18	93.14	185	81
1935 (Av.)	196.44	94.43	165.76	89.65	134	59

January construction table on page 56.



Modern architectural concrete and good workmanship feature this new home of the La Crosse (Wis.) Tribune and Leader Press. Ornamentation is clear and clean-cut. Corners are straight. The surface has a natural plywood finish and is uniform in color and texture. Architects and engineers—Kruse & Parish, Davenport, Iowa; Associate architects—Boynn, Schubert and Sorensen, La Crosse; Contractors—Theo J. Molzahn & Sons, Inc., La Crosse, Wis.

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THE WEEK'S EVENTS

Injunction on TVA Denied by Court

Supreme Court holds power companies have no ground for suit against TVA

No legal rights of the utility companies operating in the TVA area have been infringed, and the utilities, therefore, may not bring a suit attacking the constitutionality of the TVA act, the U. S. Supreme Court held Jan. 30.

The utility companies had sought a review of the constitutionality of the TVA act, but this the Supreme Court refused to pass on.

The claim of the utilities that they have a right to bring suit is based primarily, the court pointed out, on "the doctrine that one threatened with direct and special injuries by the act of an agent of the government which, but for statutory authority for its performance, would be a violation of legal rights, may challenge the validity of

(*Continued on p. 52*)

• • •

Battery-Brooklyn Bridge Proposed in New York

A bridge to connect the Battery in Manhattan with Hamilton Ave. in Brooklyn was proposed last week by Robert Moses, chairman of the Triborough Bridge Authority, as an alternative to the tunnel previously under discussion and turned down last year by PWA. The proposal has already gained considerable support among city officials, and Mayor LaGuardia has initiated informal discussions with the RFC and the War Department.

The proposed bridge would consist of two 1,600 ft. suspension spans sharing an anchorage pier in the center of the East River about 600 ft. east of Governors Island. The vertical clearance would be 135 to 150 ft., or 10 to 18 ft. more than that provided by the existing East River bridges. At all foundation locations except one, rock is less than 60 ft. below water level. At the Brooklyn end rock may be 160 ft. down.

O. H. Ammann, chief engineer of the authority, said the bridge, with six traffic lanes, would carry 7½ to 9 million vehicles in its first year and that an average toll of 27 cents would permit amortization of the cost. The Manhattan approach to the bridge, according to plans, would connect with extensions of the West Side and East River express highways, and the project includes an elevated highway in Brooklyn to connect with the Circumferential Parkway now under construction.

Moses points out that the proposed bridge, with approaches, could be built for about $41,000,000, as compared with $84,000,000 for a tunnel, and would cost about $350,000 annually to operate. He proposes that the bridge be entirely financed by the sale of revenue bonds. If these are to be Triborough Authority bonds, it is understood, that consent of two-thirds of the present bond-holders will be necessary.

• • •

Pennsylvania Halts Work On Flood Control

Work was stopped Feb. 1 on the state flood control program in Pennsylvania except on projects on which commitments had already been made; a balance of $3,000,000 in the state flood control fund was returned to the general funds of the state. Secretary of Forests and Waters G. A. Stewart said that the work is being stopped because of the state's financial condition.

Earthquake Destroys Chilean Cities

Deaths approach 30,000 and seven cities are almost completely destroyed in severe shock

An earthquake in south-central Chile, extending from just north of Santiago for 1,600 miles south, caused the death, according to press reports, of about 30,000 people and is reported to have completely destroyed the cities of Concepcion, with a population of 86,000, and Chillan, with a population of 55,000, as well as at least five smaller cities.

Reaching a grade of 11 on the international scale, according to the Salto Observatory in Chile, the quake had its epicenter almost exactly at Concepcion. (The 1906 San Francisco earthquake had a rating of 10 and the Helena earthquake in 1935 a rating of 8 on the same scale.) The disturbance was preceded by rapid changes in atmospheric pressure and, it is reported, by renewed activity of volcanic mountains nearby. It was followed by activity of a number of volcanos and by a second, less intense, earthquake Jan. 30.

Reports on the nature of damage to engineering structures are still fragmentary. According to the Chilean

(*Continued on page 53*)

PROPOSED MANHATTAN-BROOKLYN BRIDGE ACROSS MOUTH OF EAST RIVER

Engineers' Decision Overruled by Court

Buffalo judge limits discretion of engineers in passing on contract provisions

Even though a contract authorizes the engineers to decide all questions arising relative to the execution of the contract, "such determination must not be arbitrary or capricious, and the clause never yields to the engineer the judicial power of the court to interpret contracts," the Supreme Court of Erie County, N. Y., pointed out in deciding a case involving extra work on the Buffalo sewer project.

The T. Tomasetti Contracting Corp. of Buffalo held a contract from the Buffalo Sewer Authority to construct Division 10 of the sewer project. Tomasetti sublet construction of an intercepting and overflow chamber to Frank J. Hanssel Co., also of Buffalo. After the contract had been made, the engineers for the sewer authority discovered some large pipes, no longer in use, were under the location of the chamber. Several attempts to build the chamber above the pipes were unsuccessful, so the authority ordered Tomasetti and Tomasetti ordered Hanssel to tear out the pipes, which Hanssel did. Hanssel then brought suit against Tomasetti and the authority for extra compensation.

The court held that, as a subcontractor, Hanssel had no claim against the sewer authority but pointed out that the extra-work provisions of the contract between Tomasetti and the authority must govern the relations between Tomasetti and his sub-contractor.

The question then arose whether the removal of the pipe could properly be described as earth excavation and charged for at the unit price for that type of work. Engineers for the Sewer Authority testified that they regarded the removal of the pipe as earth excavation.

Tomasetti contended that this decision of the engineers must be controlling, since the contract provided that "the engineers shall in all cases determine the amount and quality of the several kinds of work which are to be paid for under this contract, and they shall determine all questions in relation to said work. . . ."

The court pointed out that prior to the preparation of the plans there had been on file with the city maps giving the location of the pipe in question and that "concededly even a casual search would have revealed this plan to the engineers; . . . certainly the responsibility is at their door."

"While there is no charge of fraud against the engineers," the court held, "they occupy already the dual position of engineers and witnesses. To allow them to assume an additional role and sit in judgment upon their own mistake against the plaintiff . . . would seem . . . to amount to injustice."

The court awarded a $35,000 claim to Hanssel against Tomasetti.

• • •

Injunction Against TVA Refused By Court

(*Continued from p. 51*)

the statute in a suit against the agent."

Since the franchises of the utility companies did not in any case include a grant of monopoly, the court held that the existence of competition did not infringe on any legal right of the utilities. "The franchise to exist as a corporation and to function as a public utility, in the absence of a specific charter contract on the subject, creates no right to be free of competition."

The court attached no weight to the further claim that the utilities might challenge the constitutionality of an act which results in competition with them. "This is but to say," the court held, "that if the commodity used by a competitor was not lawfully obtained by it, the corporation with which it competes may render it liable in damages or enjoin it from further competition."

The utilities further claimed that state laws requiring a public utility to obtain a certificate of convenience and necessity "afford a protection from the authority's competition, since any utility now seeking to serve in their territory must obtain a certificate and hence they have standing to maintain this suit against the authority, which has none." On this point, the court pointed out that all of the states in which TVA is operating had specifically authorized municipalities and cooperatives to operate electric distribution systems and to purchase power from TVA. "The declaration of a specific [legislative] policy creates no vested right to its maintenance," the court said.

The final contention of the utilities was that by cooperating with PWA in the making of grants to municipalities for construction of distribution systems, TVA had been guilty of conspiracy to injure the business of the utilities. The high court upheld the finding of fact by the Tennessee district court that there had been no such conspiracy and pointed out moreover that "cooperation by two federal officials . . . does not spell conspiracy."

Boston Water Supply Head Dies at Sixty-Eight

Frank E. Winsor, chief engineer since 1926 of the Boston Metropolitan District Water Supply Commission, died of a heart attack Jan. 30 while testifying in a claims case at the Boston office of the commission. He was 68 years old.

Winsor graduated from Brown University in 1891 and later received the degrees of civil engineer, master of arts, and doctor of science from the same institution. After his graduation, he worked until 1902 on various phases of sewer and water supply construction at Boston. He spent a year as assistant engineer in the New York City water supply system and then returned to Boston to work on the Charles River basin development. In 1906 he became a division engineer on construction of New York City's Catskill waterworks and spent nine years on that work, rising to the rank of department engineer.

Winsor then became chief engineer of water supply for the city of Providence and held that post for ten years, leaving in 1926 to head the Boston Water Commission.

Winsor was a past president of the Boston Society of Civil Engineers and the New England Water Works Association as well as a former vice-president and director of the Am. Soc. C. E.

• • •

Milwaukee Filter Opening Awaits Plant Adjustment

Opening of Milwaukee's $5,000,000 water filtration plant, originally scheduled for last October but delayed by technical difficulties, has been further delayed to permit check-up and adjustment of the mechanical equipment which was indicated as desirable by the preliminary tuneup of the plant.

In addition, it is expected that James Kerslake, the newly appointed superintendent, who took up his duties Feb. 1, will want some time to familiarize himself with the plant and his staff.

• • •

Timber Bridge Design Contest Announced

A prize of $500 and subsidiary prizes totaling $1,000 are being offered for the best design of a timber bridge by the Timber Engineering Co. The contest is being held under the auspices of the company and the National Lumber Manufacturers Association and the American Forest Products Industries, Inc. The prize money is being divided into two classifications, one for all contestants and the other for students only.

Highway Work Delayed By Colorado Wage Dispute

Colorado's $9,000,000 highway construction program for 1939 will be delayed five to seven weeks as the result of disputes which have arisen concerning the wage rates to be paid on work which has been put under contract by the state highway department. The department has announced that no more projects will be advertised for bids until the state industrial commission has determined the wage scale to be paid on future work.

Organized labor in the state claims that the wage rates which the highway department has been using in its bid calls are too low. The rate was set by the state industrial commission in 1936. On work within a 15-mile radius of Denver, the rate for skilled labor is $1.25; for semi-skilled, 70¢ per hour; and for common labor, 55¢ per hour. Elsewhere in the state the rates are $1.10, 70¢, and 50¢.

The wage rates on the $625,000 Littleton-Denver project in the Denver area were attacked in the courts by the Denver building trades council, and the case is now before the state industrial commission for determination. At the present time the state highway department is holding up thirteen projects amounting to about $2,000,000 until the commission reaches a decision.

Not Home Monday

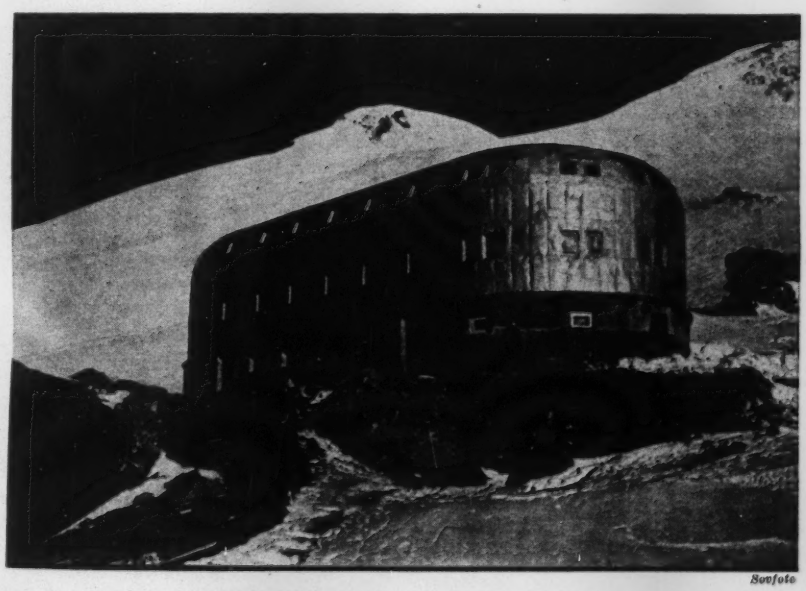
In order that "certain officials may have some time to devote to departmental business without interruption," Ohio director of highways Beightler has announced that neither he, his assistant, nor the chief engineers of the principal bureaus will make appointments to see anyone on Monday except in cases of emergency or extreme necessity.

• • •

Oklahoma Stops Payment On Highway Debt

Payment has been halted on about $5,479,000 of claims outstanding against the Oklahoma state highway department. The action was taken by the new administration of Governor Phillips pending a determination of whether the state may legally pay the bills, since the Oklahoma constitution limits the indebtedness of the state to $400,000. The state attorney-general has been asked for an opinion on the status of the outstanding claims. In future the highway department will operate on a cash basis.

The governor said that most of the highway department work in the future will be done on a contract basis, although the previous administration did much of its work on force account.



Sovfoto

HOTEL ON EUROPE'S HIGHEST PEAK

STREAMLINED to minimize the effect of extremely high wind velocities, this hotel is being completed in the Caucasus by the Soviet government on the slopes of Mt. Elbrus, the highest mountain in Europe. The hotel is built at about 15,000 ft. elevation.

In building the hotel, it was necessary to construct a 10-mile road to the site before work could be started. An unusual feature of the hotel will be complete photographic equipment for the many photographers who are expected to visit the mountain.

Seismic Study Held Aid in Road Work

University of Colorado holds thirteenth annual highway engineering conference

The use of seismographic exploration in studying highway foundations, although still experimental, appears to have extensive possibilities, W. L. Eager, assistant highway engineer of the U. S. Bureau of Public Roads, told the engineers and contractors gathered from the Rocky Mountain region for the highway engineering conference held at Boulder, Colo., Jan. 19-20. The conference was sponsored by the civil engineering department and the extension department of the University of Colorado and was directed by C. L. Eckel, head of the department of civil engineering.

By the seismographic method, Eager said, type and depth of material to be encountered in road cuts as well as the nature of foundation materials at bridge sites can be determined. Speaking on the same subject, C. A. Hiland, professor of geophysics at the Colorado School of Mines, pointed out that there is a very close relation between the applications of seismic methods in oil exploration and those in highway and building work.

Equipment cost

Edward H. Honnen, president of the Colorado Association of Highway Contractors said that cost data on highway construction contracts in Colorado show that the cost of the equipment used on large highway contracts often exceeds the entire cost of the project. His paper, "Cost Analysis of Construction Equipment," pointed out that it is therefore of vital importance that the contractor know as much as possible about the operation and maintenance cost of his equipment.

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Earthquake Demolishes Seven Chilean Cities

(*Continued from page 51*)

Embassy at Washington, all of the older buildings and most of the smaller ones in the earthquake zone were constructed of adobe blocks. There are some modern buildings of steel frame construction, but no information is available as to how these withstood the shock. Most of the public buildings are of solid masonry, and some of these were destroyed. None of the towns affected was on the seashore, most of them being at the foot of the mountains which rise about 20 miles inland.

WASHINGTON HIGHLIGHTS

Special reports by Paul Wooton

BONNEVILLE Administrator Ross is understood to have asked an appropriation subcommittee of Congress for $14,400,000 for the fiscal year beginning July 1, 1939, for extension of the Bonneville transmission network and operation of the existing lines. Of this, $14,000,000 would be for new construction and $400,000 for administration.

AN AUTHORITY to carry out in Arkansas a program similar to that of TVA is proposed in a bill introduced last month by Representative Ellis of Arkansas. A series of dams and power plants in the White River valley would be built by the White River Authority, a public corporation having power to issue $50,000,000 in bonds. The authority would have power to build ten major multi-purpose dams in Arkansas and Missouri as well as nineteen smaller ones and six locks.

FHA INSURANCE of large-scale rental housing developments was greater in January than in any previous month in FHA's history, with mortgages arranged totaling $11,204,000 for nine large projects in six states. FHA administrator McDonald expects increased activity in this field in the early spring.

NOMINATION of Thos. R. Amlie to be a member of the Interstate Commerce Commission is thought by some an indication that the President sees a possibility that the government may have to take over the railroads. With that eventuality in view he may have concluded that it would be well to have an enthusiastic believer in government ownership behind the scenes where he could study the problem from that angle.

NO MODIFICATION of the existing flood control projects on the Merrimack River in New Hampshire and Massachusetts should be made, the War Department advised Congress, Jan. 23.

A UNIFORM SYSTEM of motor traffic regulation in states receiving federal aid is proposed in a bill introduced by Representative Dirksen. The Secretary of Agriculture would set up a uniform system of regulation and refuse federal aid to states not adopting it within two years.

REIMBURSEMENT to states of 50 per cent of the cost of toll bridges which are later made free if the bridge has been built without federal aid but in accordance with federal standards would be provided by a bill introduced by Representative Guyer.

THE GEORGIA maintenance tax imposed on vehicles using the state highways does not constitute an interference with interstate commerce, the U. S. Supreme Court held Oct. 30. The court pointed out that no discrimination is made between interstate and intrastate commerce by the tax.

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Walsh-Healey Amendments Would Extend Act

Six amendments to the Walsh-Healey Act, which requires government contractors to abide by certain wage and hour restrictions in fulfilling contracts, have been introduced into Congress by the original sponsors of the measure, Senator Walsh and Representative Healey.

The effect of the proposed changes would be to extend to all government contracts the present Navy clause limiting profits to 10 per cent; to lower the present $10,000 exemption limit to $2,000; to bring under the act non-professional service contracts (with laundries, for example); to harmonize the Walsh-Healey provisions with the Fair Labor Standards Act by permitting wage deductions for board and lodging; by lowering the minimum age of workers to 16 in non-hazardous occupations; and to permit the recovery by employees in cases of violation, of double the wage deficiency for a second offense, and triple for a third.

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FTC Attacks Price-Fixing In Chemical Supplies

The Federal Trade Commission has ordered a group of manufacturers of chlorine and another group of manufacturers of calcium chloride, both groups representing substantially their entire industry, to cease and desist from entering into concerted action to fix and maintain uniform or enhanced prices in the sale of the product. Both orders direct the companies to stop dividing the United States into zones for the sale of their products, and in the case of the calcium chloride industry the manufacturers are also ordered to discontinue suggesting resale prices to distributors and offering identical bids; they are also directed to eliminate cash discounts for prompt payment.

Committee Will Advise On Public Works Plans

Appointment of a technical public works committee to advise the National Resources Committee on problems relating to the economics and timing of public construction activities has been announced. The group will assist in the preparation of the NRC's six-year construction program for federal, state and local governments and will, in addition, undertake studies regarding the effective utilization of state and local public works expenditures as a stabilizing influence for the construction industry and as a means of employment.

Henry M. Waite is chairman of the committee and Frank W. Herring, of the American Public Works Association, is vice-chairman. Other members are: F. E. Schmitt, editor of *Engineering News-Record;* Otto T. Mallery, Pennsylvania State Planning Board; William Stanley Parker, Construction League; Frederick J. Lawton, Bureau of the Budget; Corrington Gill, WPA; Fred Schnepfe, PWA; Lowell Chawner, Department of Commerce; A. F. Hinrichs, Department of Labor; Lt.-Col. Paul W. Baade, War Department.

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Highway Reflectors Placed On Second Michigan Road

Because a substantial reduction in accidents was observed after the installation of reflectors along U.S. 16 between Detroit and Lansing (*ENR*, April 14, 1938, p. 541), the Michigan state highway department has installed reflectors along the 62-mile section of U.S. 24 which runs from the Ohio state line north to Pontiac.

During the 6-month period after the reflectors were installed on U.S. 16 there were only 36 night accidents as compared with 91 the preceding year. Although some widening and other physical improvement had been done on U.S. 16, this reduction was so greatly in excess of reductions on other state highways during the same period that the installation was stated by Highway Commissioner Murray D. Van Wagoner to be a "completely successful demonstration of what the reflectors can do."

U.S. 24, selected for the second demonstration, includes sections with the highest accident rate in Michigan. Traffic ranges from a daily average of 5,480 to a maximum of 15,000 vehicles. During the past four years there have been 113 fatal accidents along the section on which reflectors have now been installed, of which 71 were night accidents.

Court Refuses Damages For River Shift

A landowner, part of whose land was cut away by the Mississippi River after the current had been shifted by federal construction of levees, is not entitled to be paid damages by the federal government, a circuit court of appeals ruled last month. Upholding a decision of the Memphis district court, the court dismissed the claim of two landowners who own property on the Mississippi River near Randolph, Tenn.

Seeking $10,000 each in damages, the claimants asserted that dikes built in 1931 on the Arkansas side of the river a short distance above their property so diverted the current from its natural course that it was directed against the Tennessee bank and within a year had washed away all but a few acres of their land.

The appellate court pointed out that "the United States did not physically invade the land nor oust the owners from possession.

"The fact that the current was altered by the dikes constructed for improvement of navigation is no occasion for modifying the general rule that, in absence of an actual injury upon and invasion of private property, the damage done by erection of lawful construction in a navigable river is as a matter of law consequential and that no recovery can be had apart from the statute."

The court said that the rights of private owners of land forming the banks and bed of a navigable stream are essentially secondary to the needs of navigation.

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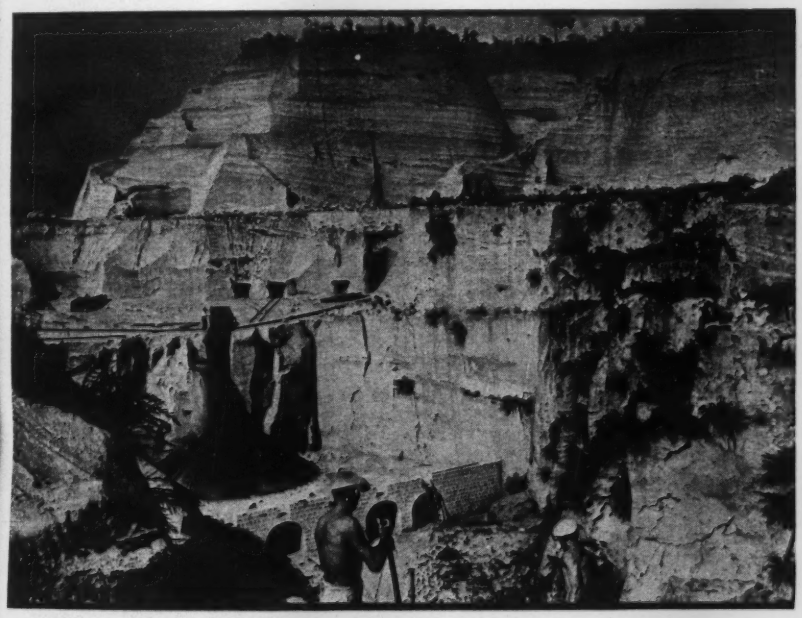
Correction

In the news item on p. 9 of the Jan. 26, 1939 issue relating to a decision of the Supreme Court of Canada regarding payments to a contractor on a job where a change of plans occurred during the course of the work several years ago, the Raymond Concrete Pile Co. referred to is the Raymond Concrete Pile Co., Ltd., of Canada. This company is not in anywise connected with or related to the Raymond Concrete Pile Co. of 140 Cedar St., New York City, well known to U. S. engineers and contractors.



WHERE CAESAR GOT HIS POZZOLANA CEMENT

THE REVIVAL of interest in special cements and the attempt to recapture in modern cements some of the useful qualities of the old natural cements has brought the ancient word "pozzolana" back into the engineer's vocabulary. Taking its name from the small Italian town of Pozzuoli, pozzolan cement is said to have first been quarried at Bacoli, near Naples. Ancient Rome was built with pozzolana of Bacoli, and from the same quarry, pictured above, 500,000 tons of this volcanic material are still taken annually. Important recent uses of pozzolana of Bacoli are in the harbor works at Naples, Genoa and Trieste.

American pozzolans are clay, shale, volcanic ash, diatomaceous earth and similar siliceous materials that, in the presence of moisture, form insoluble compounds with lime. Modern practice is to combine pozzolanas with portland cement.

Building Costs Are Discussed

Construction costs are a major issue at Public Housing Conference in New York

None of the subjects discussed at the annual convention of the National Public Housing Conference in New York City, Jan. 27-28—among them land costs, subsidies, operating personnel, legislation and construction costs—attracted a more interested audience than to construction costs.

Outstanding among the addresses was one by Hugh L. Dryden, coordinator of housing materials research of the National Bureau of Standards. Mr. Dryden listed four significant ways to reduce housing costs: (1) revalue standards of space and equipment so that public housing will be no larger or better equipped than decency and health demand; (2) develop new suitable materials at lower cost, often as by-products of basic research which may be primarily interested in other objectives; (3) devise better uses of existing material so that we may use less of them or make one material do two different jobs; and (4) increase the efficiency and productivity of labor.

At the same session, Wilson Compton of the National Lumber Manufacturers' Association described the significant efforts that private industry already has made to reduce the cost of housing. Mr. Compton pointed out that a great many people held to be the object of public housing effort can afford to own their own homes, since a five-room timber house can be built in suburban New York territory for $2,500 and for $1,800 or less in Oregon and Georgia. Mr. Compton revealed that the lumber industry is planning to build a house with no studs, rafters or joists, reducing both the amount of material and the labor costs. If private industry can produce houses at $500 a room, said Mr. Compton, it will leave more money for justifiable public housing.

In so far as labor costs are concerned, M. H. Hedges, International Brotherhood of Electrical Workers, pointed out that labor was unwilling to test the theory of reducing wages to build more houses. Such wage cutting, he maintained, would be ineffective since a 10 per cent cut would reduce the building cost only 3 per cent. Labor, he said, would probably oppose force account work on public housing, prefering to work with contractors who are the technical agencies of the present building industry. He proposed setting up a joint commission of workers and employees to consider all of the difficult problems involved.

Reclamation Budget Is Increased

Budget bureau recommends nearly fifty million for reclamation projects in 1939-40

Construction projects of the Bureau of Reclamation have fared well at the hands of the Budget Bureau, and reclamation officials consider the appropriations in the budget report ample to carry on the construction program for the next fiscal year. With seven fewer projects listed than in the previous budget, the appropriations recommended by the Budget Bureau are about $10,000,000 more than was appropriated for the 1939 fiscal year.

Altogether, $49,648,000 is asked in the new budget for continuing reclamation construction projects for the 1940 fiscal year. All projects which had appropriations for 1939 except two that have not yet started, have received funds. The two exceptions are the projects at Deschutes, Oregon, and at Twin Springs, Idaho.

Five other projects were dropped from the list of appropriations requested, because these are completed or have funds available. The projects dropped are: Ogden River, Utah; Upper Snake, Idaho; Sun River, Montana; Klamath, Oregon and California; Marshall Ford Dam, Texas.

Last year, the Bureau of Reclamation projects received a total appropriation of $39,615,000, and, in addition, there was a PWA allotment of $28,750,000, which remains available for the next two fiscal years.

No new projects are listed in the Reclamation Bureau estimates for the 1940 budget. Those listed, with amounts recommended, are:

Reclamation Fund	
Gila project, Arizona	$700,000
Colorado-Big Thompson project, Colorado	1,500,000
Pine River project, Colorado	1,000,000
Boise project, Payette division, Idaho	500,000
Minidoka project, Idaho	100,000
Carlsbad project, New Mexico	100,000
Tucumcari project, New Mexico	250,000
Rio Grande project, Elephant Butte Power, New Mexico	483,000
Owyhee project, Oregon	270,000
Rove River project, Utah	1,500,000
Yakima-Roga Roza project, Washington	1,000,000
Riverton project, Wyoming	100,000
Kendrick project, Wyoming	1,000,000
Shoshone project, Wyoming	450,000
General Investigations	200,000
Administrative expenses	750,000
TOTAL	$9,948,000
General Fund	
Boulder Canyon, Arizona and Nevada	$4,000,000
All American Canal, California	2,000,000
Central Valley project, California	10,000,000
Columbia Basin, Grand Coulee Dam project, Washington	23,000,000
Administrative expenses	700,000
TOTAL	$39,700,000
GRAND TOTAL	$49,648,000

Reclamation Bureau budget estimates are being considered by the House appropriations sub-committee. John C. Page, Commissioner, and other officials of the Reclamation Bureau testified.

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Last Building Code Section Passed in Chicago

A dozen years' work on a new building code for Chicago was completed Jan. 25 when the city council adopted the final seven chapters of the code. These chapters cover such subjects as safety measures and accepted methods and materials. The chapters relating to engineering were passed in 1937, shortly after the decision was made to submit the code for approval by sections.

An outstanding feature of the final sections is the provision for establishment of a committee on standards and tests, which is expected to keep the code constantly up to date. The committee, made up of three aldermen, three licensed engineers and architects, and the building commissioner, does not have the power to revise the building code ordinance, but it will make recommendations for amendment.

Oklahoma Road Body Is Reorganized

The Oklahoma State Legislature has reorganized the state highway commission as a three-man body. The three members of the new commission will be appointed by the governor with the confirmation of the Senate and may be removed at any time by the governor. Salaries will be $5,400 per year.

Previously, the Oklahoma highway commission consisted of four men drawing salaries of $4,800. The state engineer voted as a member in case of a tie.

The only member of the new commission so far appointed is the chairman, Sandy Singleton.

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Safety Code Announced On Air Equipment

A safety code covering the manufacture and use of compressed air machinery and equipment has been completed and approved by the American Standards Association. Developed in cooperation with a number of national organizations and departments of the federal government, the code is designed to serve as a guide to states and municipalities wishing to regulate the use of compressed air and also for voluntary use by concerns manufacturing or using such equipment. The code includes specific recommendations for the construction and use of compressors, tanks, and pipelines, as well as sections on receivers and utilization apparatus.

The code is being published by the American Society of Mechanical Engineers in a 9 page booklet available either from the society or from the standards association at a cost of 30 cents.

Further news on p. 106

ENGINEERING CONSTRUCTION CONTRACTS REPORTED BY ENGINEERING NEWS-RECORD, IN JANUARY, 1939

Engineering News-Record *reports projects of the following minimum costs: Waterworks, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000 *industrial buildings,* $40,000; *other buildings,* $150,000.

Four Weeks — Thousands of Dollars (000 Omitted)

Public Works	New England	Middle Atlantic	South	Mid West	West of Mississippi	Far West	United States January 1939	United States January 1938	Canada
Waterworks	5,092	14,239	2,121	2,516	4,577	2,910	31,455	2,773	108
Sewerage	1,580	7,798	1,219	4,663	3,223	1,150	19,633	12,136	25
Bridges, public	3,614	4,660	4,342	2,235	2,486	8,152	25,489	5,985	454
Earthwork and waterways	116	5,838	5,721	1,499	2,876	5,108	21,158	10,286	26
Streets and roads	368	17,222	5,559	8,858	21,527	8,717	62,251	28,191	398
Buildings, public	7,538	26,830	6,887	22,725	16,985	7,436	88,401	37,740	800
Unclassified, public	502	2,044	2,742	1,132	2,015	3,580	12,015	13,608	1,143
Total public	**18,810**	**78,631**	**28,591**	**43,628**	**53,689**	**37,053**	**260,402**	**110,719**	**2,954**
Federal government (included in above classifications)	207	8,186	3,388	3,307	8,127	8,137	31,352	12,912	.....
Private									
Bridges, private	.....	856	.....	.....	.....	.....	856	135	.....
Buildings, industrial	95	4,218	408	1,718	1,216	1,016	8,671	26,648	80
Buildings, commercial	3,860	18,841	1,194	3,667	753	2,286	30,601	46,161	250
Unclassified, private	745	707	4,540	1,687	3,168	316	11,163	6,523	585
Total private	**4,700**	**24,622**	**6,142**	**7,072**	**5,137**	**3,618**	**51,291**	**79,467**	**915**
Total Engineering Construction									
January, 1939 (4 weeks)	**23,510**	**103,253**	**34,733**	**50,700**	**58,826**	**40,671**	**311,693**	.....	**3,869**
December, 1938 (5 weeks)	24,538	107,940	48,721	53,898	62,659	41,494	339,250	.....	10,804
January, 1938 (4 weeks)	6,188	70,603	30,967	25,731	39,153	17,544	.....	190,186	4,062

Engineering News Events of 1938

IN ANY REVIEW of the year, the time factor has its importance; frequently it is necessary or at least interesting to know how early in the year the discussion of a renewed public works program started, in what month work began on Shasta Dam. It is to answer such questions that this chronological summary of the outstanding engineering events of 1938 was compiled.

The italic dates in parenthesis indicate the issue of *Engineering News-Record* in which fuller information may be found.

PWA AID to municipal power projects upheld by U. S. Supreme Court. (*Jan. 6*)

STATE HIGHWAY DEPARTMENTS asked by Secretary Wallace not to submit definite projects for federal aid until Congress has considered the President's recommendation that the 1939 federal aid allotments be cancelled. (*Jan. 6*)

REDUCTION of federal public works by about $137,000,000 recommended in the President's budget message. (*Jan. 13*)

CONSTITUTIONALITY of the TVA Act and the right of the TVA to sell electricity upheld by a three-judge federal district court. (*Jan. 27*).

FALLS VIEW BRIDGE at Niagara Falls, N. Y., torn from its foundations and completely wrecked by an ice jam. (*Feb. 3*)

GRAND COULEE high dam contract awarded to Interior Construction Co. for $34,442,000. (*Feb. 3*). (Name later changed to Consolidated Builders Inc.).

FEBRUARY

TWENTY-TWO PER CENT of the present cost of Bonneville Dam charged to power by Federal Power Commission. An ultimate development, 57 per cent will be charged to power. (*Feb. 17*)

DRASTIC LIMITATION on width and weight of trucks in South Carolina upheld by the U. S. Supreme Court. (*Feb. 17*)

Failure, in September, 1937, of Wyandotte County Lake Dam in Kansas was caused by squeezing out of pockets of plastic material in the foundation, it is reported by board of engineers (*Feb. 24*). The county applies to WPA for aid in rebuilding the dam. (*March 31*)

MARCH

SOUTHERN CALIFORNIA coastal plain swept by flood resulting from heavy rainfall in mountain areas bordering Los Angeles-Riverside district. Streamflows exceeding all previous records do extensive damage to railways, highways, and wire communication. Rainfall in Los Angeles area heaviest recorded for any comparable period. Property losses estimated at more than $50,000,000 and deaths at more than 200. (*March 10*)

CHAIRMAN MORGAN of TVA directorate issues statement charging "lack of honesty, openness, decency, and fairness" on the part of the other directors in handling of Berry marble claims. President Roosevelt then releases statements by Directors H. A. Morgan and Lilienthal charging the chairman with obstructing the work of the board (*March 10*). President demands that Chairman Morgan present evidence of his charges, but the chairman refuses to testify except before a Congressional committee (*March 17*). Because of this refusal, Arthur Morgan dismissed as chairman of the TVA and H. A. Morgan made chairman (*March 24*). Congress votes to name a joint Congressional committee to investigate TVA. (*March 31*)

CANCELLATION of 1939 federal aid road allotments, as proposed by the President, shelved when the Secretary of Agriculture withdraws his request that the states delay submission of roadbuilding projects. (*March 24*)

INTERSTATE COMPACT for flood control on Connecticut River approved by Senate, which immediately votes to reconsider its action. The compact fails to receive Congressional approval. (*March 31*)

APRIL

ALL CEMENT used by federal agencies will be purchased through the Procurement Division on open quantities, f.o.b. mill, the division announces. (*April 7*). At first letting, competitive bids are received in Great Lakes and Pacific Coast areas but in other areas and on special cements bids are negligible. Eight major producers decline to submit any bids. (*April 21*). All bids are rejected. (*April 28*). The plan is changed to provide for bids on a definite quantity at a stipulated rate of delivery. (*May 5*)

UNAPPROPRIATED WATER in the Western States belongs to the federal government, U. S. Attorney General claims before the Supreme Court. (*April 7*)

SALE of Hetch Hetchy power by San Francisco to private utility held a violation of the Raker Act by federal district court. (*April 14*)

INCREASED APPROPRIATIONS for relief and a $1,462,000,000 public works program urged by the President in a message to Congress. (*April 21*)

AN INTERSTATE COMPACT for division of river water takes precedence over rights of private water users, the U. S. Supreme Court holds in the La Plata River case. (*April 28*)

A DAM not built on navigable water need not be licensed by the Federal Power Commission, U. S. district court in Virginia holds in Appalacian Power Co. case. (*April 28*)

GENERAL STRIKE on federally-financed building projects in the St. Louis area called by the building trades council to force employment of union men on a bridge repair project partly financed by federal highway aid allotments. (*April 14*). Strike called off after two weeks when the contractor shut down the bridge job. (*April 28*).

HIGHWAY COMMISSIONER MacDonald of Connecticut dismissed by Governor on recommendation of a Grand Jury which had indicted a highway department employee for fraud on land purchases for the Merritt Parkway. (*May 5*)

MAY

NORTH TUBE of Lincoln Tunnel under the Hudson River holed through. (*May 5*)

PROCUREMENT DIVISION asks new bids for definite quantities of cement in five regions, f.o.b. mill or storage point (*May 12*). Central cement purchase plan modified to permit Bureau of Reclamation to purchase special cements direct. (*May 19*)

THREE POWER DISTRICTS in Nebraska ask PWA's consent to buy out all private utilities in Nebraska, setting up a statewide public power system. (*May 19*)

AFL AND USHA agree that low-rent housing projects will not be halted by jurisdictional disputes and that wage rate will be held constant through life of each project. (*May 19*). Agreement to this effect with central building trades bodies signed in over 50 cities. (*July 7*)

EIGHT STATES in the Ohio Valley negotiate a river sanitation compact for the valley, and submit it to the state legislatures for ratification. (*June 2*)

JOINT CONGRESSIONAL COMMITTEE investigating TVA begins its hearings. (*June 2*)

JUNE

A FEDERAL-AID bill providing $100,000,000 and $115,000,000 for 1940 and 1941 respectively and $20,000,000 and $30,000,000 for grade crossing elimination in the two years passed by Congress. (*June 9*)

FEDERAL-AID allotment to Massachusetts for 1938 cut one-third because the state diverted motor vehicle revenues to nonhighway purposes. (*June 9*)

COST of the three completed TVA dams allocated 52 per cent to power, 20 per cent to flood control and 28 per cent to navigation in a report submitted to the President by TVA and approved by him. (*June 23*)

PASSENGER TRAIN of the C.M.St.P.&P. R.R. breaks through Custer Creek Bridge in Montana, killing 47 people; bridge piers had been undermined by cloudburst. (*June 23*)

CONGRESS passes a $3,000,000,000 relief and recovery bill, appropriating $1,425,000,000 for eight months operation of WPA, $955,000,000 for PWA, and increasing USHA bond authorization to $800,000,000 and subsidy appropriation to

an annual $28,000,000 (*June 23*). Nearly 2,000 projects were approved by PWA within three days after the President signed the bill. (*June 30*)

FLOOD CONTROL BILL assigns to the federal government all costs in connection with dams, reservoirs and channel improvements retroactively to 1928, and vests title to land and power in the federal government. Land and rights-of-way for local protective works are still to be furnished locally. (*June 23*)

CENTRAL CEMENT PURCHASING plan further modified to permit federal agencies to buy small quantities through local dealers. (*June 23*)

A FIRE under high pressure air in the north tube of the Queens Midtown Tunnel under the East River in New York City causes collapse of the shield breasting and flooding of the tunnel; no lives are lost. (*June 30*)

BARKLEY-VINSON BILL setting up a division of water pollution control in the Public Health Service and authorizing loans and grants for construction of purification works (*June 16*) vetoed by the President because it provides no executive review of projects authorized. (*June 30*)

A BOND ISSUE of $20,000,000 for municipal housing projects in New York City is provided for when the city establishes a tax on rented business properties, the receipts from which will service the bonds. (*June 30*)

JULY

FOURTEEN DAMS of the Muskingum watershed conservancy district completed by the army and turned over to the district. (*July 7*)

IMPROPER PROCEDURE by the Ohio highway department in purchasing truck-mixed bituminous concrete charged by an investigating committee appointed by the governor. A taxpayer obtained an injunction against payment to the bituminous concrete firms. (*July 7*)

ARTHUR E. MORGAN, former TVA chairman, files suit challenging his removal and suing for back salary. (*July 14*)

No PWA ALLOTMENTS will be made for municipal power projects competing with existing systems unless municipalities have been unable to purchase private utilities, Ickes announces. (*July 14*)

PHILADELPHIA ordered by Pennsylvania state sanitary water board to treat its sewage and stop polluting the Delaware and Schuylkill Rivers. (*July 14*)

PWA APPLICATION of the city of Riverside, Calif. suspended by Administrator Ickes because the city hired a lobbyist. (*July 21*)

WORK STARTS on first USHA housing job, Red Hook project in Brooklyn, N. Y. (*July 21*)

TEN TUNNEL WORKERS killed by a premature explosion of dynamite in the Gunpowder Falls-Montebello water tunnel at Baltimore. (*July 28*)

CIO CONTRACT covering technical employees signed by the architects on the Queensbridge USHA housing project in New York City. (*July 28*)

CHICAGO receives a PWA grant for the $21,000,000 South Side filtration plant. (*July 28*)

PENNSYLVANIA TURNPIKE receives PWA grant of $26,000,000; RFC will loan remainder of $60,000,000 cost. (*Aug. 4*)

AUGUST

UNION CONTRACT with CIO engineers' union signed by Minnesota highway department. (*Aug. 25*)

PWA RESCINDS allotments on a number of California projects and reduces the amount of the grant on others where sponsors have employed a lobbyist. (*Sept. 1*)

SEPTEMBER

SHASTA DAM construction ordered started as the Bureau of Reclamation completes a contract with the Southern Pacific for relocation of tracks through the dam site. (*Sept. 15*)

CONTROL LOCKS for the Chicago River dedicated by the Chicago Sanitary District. (*Sept. 15*)

PHILADELPHIA given three weeks by the State Attorney General's office to take steps to treat its sewage (*Sept. 15*). The city sets up a city authority to finance with revenue bonds a $40,000,000 improvement to the city's sewage treatment and water supply facilities. (*Sept. 22*).

FIRST USHA PROJECT to get under contract, Red Hook Houses in New York City, will cost $850 per room to build plus a land cost of $275 per room, construction bids indicate. (*Sept. 22*)

COMPLETION of the Quabbin reservoir work of the Boston water supply commission was provided for by a $7,000,000 PWA grant. (*Sept. 22*)

ARCHITECTURAL FIRM on Red Hook USHA housing project signs union contract with AFL engineers' union. (*Sept. 22*)

EIGHT MILLION-YARD section of upstream face of Fort Peck dam slides down, carrying out the core pool and killing eight men. (*Sept. 29*)

A TROPICAL HURRICANE strikes inland across Long Island and New England producing, in combination with floods, damage estimated at $200,000,000 and the loss of about 500 lives. (*Sept. 29*)

SPHEROIDAL OIL TANK at Sarnia, Ont., explodes when a bad weld fails; one man killed. (*Sept. 29*)

TORNADO at Charleston damages 67 old buildings. (*Oct. 6*)

OCTOBER

PWA GRANTS $12,000,000 to New York City for construction of a circumferential parkway around Brooklyn and Queens. (*Oct. 6*)

IMMEDIATE EXPENDITURE of $11,000,000 on emergency flood control projects in New England recommended by Army, FPC and PWA. (*Oct. 6*)

PLANS for central purchase of cement dropped by the federal government. (*Oct. 6*)

CHICAGO SUBWAY receives PWA grant of $18,000,000. The $40,000,000 plan adopted is one of two drawn up by a special board of engineers appointed by Ickes to study the project. (*Oct. 13*)

CONCRETE PONTOON BRIDGE across Lake Washington at Seattle receives PWA grants totaling $3,741,000. (*Oct. 27*)

FORT PECK DAM receives an additional $2,000,000 from the War Department, which announced that completion of the project would be delayed until 1940 by the September slide. (*Oct. 27*)

MOST EMPLOYED ENGINEERS are not professionals for the purposes of the wage-hour act, according to a definition announced by Administrator Andrews. (*Oct. 27*)

NOVEMBER

EXPLOSION in pipe gallery of Dayton, Ohio, sewage disposal plant cripples the plant causing $10,000 damage. (*Nov. 17*). Investigation lays the blame on escaping sewer gas from a rebuilt trap. (*Dec. 1*)

CONSTITUTIONAL AMENDMENT authorizing New York State to loan $300,000,000 to local authorities for low-rent housing and providing annual subsidies up to $5,000,000 approved by voters. Another amendment limits railroad contributions to cost of grade separation projects to 15 per cent, and a third authorizes New York City to issue bonds up to $315,000,000 to unify its transit system. (*Nov. 17*)

SAN JACINTO TUNNEL on the Colorado River aqueduct holed through. (*Nov. 24*)

OHIO HIGHWAY DIRECTOR, his assistant, and nine division engineers resign as a repercussion of the Democratic primary fight and the election of a Republican governor. (*Nov. 24*)

DIVERSION of gasoline taxes prohibited by constitutional amendments passed in California, Michigan and New Hampshire. (*Nov. 24*)

PWA COMPLETES allotment of its funds. Grants made to 1,059 federal projects costing $200,000,000, and to 6,333 non-federal projects costing $1,477,995,000. (*Dec. 1*)

FIRST PWA GRANT for a competitive power system put into effect when Ickes decides Columbus, Miss., has been unable to purchase its private utility. (*Dec. 1*)

SIXTH AVENUE ELEVATED LINE in New York condemned by the city, which thereupon sells it for $80,000 to a West Coast wrecking firm, rescinding the sale when the purchaser fails to make a deposit and resells it to the Harris Structural Steel Co. for $40,000. (*Dec. 8*)

DECEMBER

ALL AVAILABLE USHA funds either loaned or earmarked, Administrator Straus announces; limitation of the annual subsidy to $28,000,000 prevents loaning more than $647,575,000, although Congress authorized $800,000,000. (*Dec. 15*)

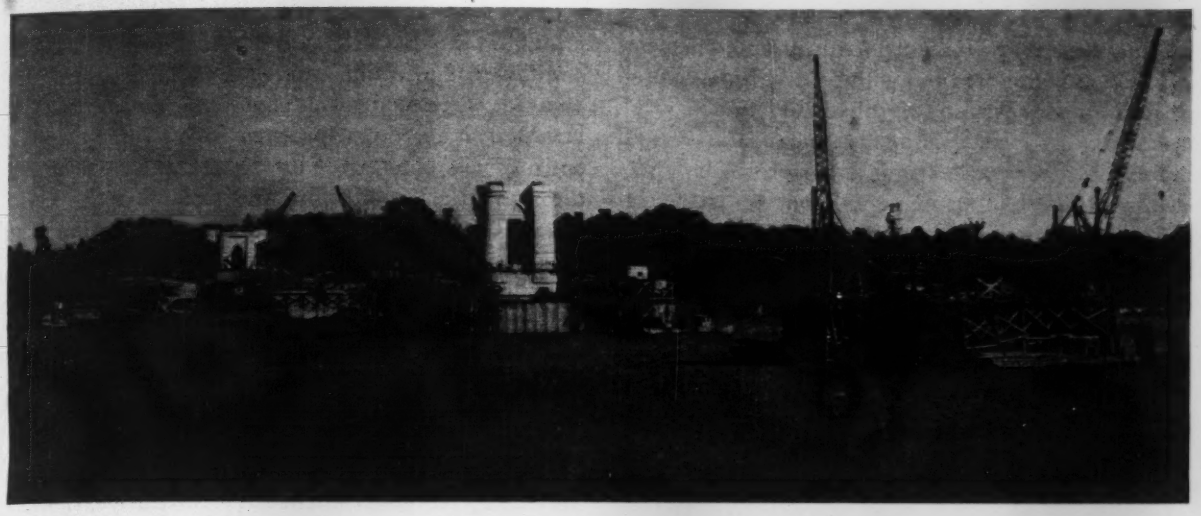
PUMPING STATIONS of the St. Louis waterworks system shut down by a four-day strike of operating engineers involved in a dispute between the firemen's and engineers' unions, both AFL. Water service maintained throughout the strike which ends with the *status quo* on union recognition unchanged. (*Dec. 22*)

LIMIT on FHA insured mortgages increased from $2,000,000,000 to $3,000,000,000 by Presidential proclamation. (*Dec. 22*)

LAKE PONTCHARTRAIN toll bridge purchased by the State of Louisiana and made a free bridge. (*Dec. 29*)

DIVERSION of water at Chicago from Lake Michigan into the Chicago River reduced to 1,500 sec.-ft., carrying out a U. S. Supreme Court order. (*Jan. 5, 1939*)

ICKES ANNOUNCES that 7,853 PWA projects are under contract. (*Jan. 5, 1939*)



ANOTHER BRIDGE BEING BUILT ACROSS THE LOWER MISSISSIPPI, THIS TIME AT BATON ROUGE, LA.

Civil Engineering and Construction in 1938

An Editorial Review

IN THE MIDST of confusing trends and powerful political and economic cross-currents the American world looks forward from a year of sharp recession to resumed recovery. As construction, though in some respects distinct from general industry and business, is yet closely related to them, it is important to recall that 1938 saw recovery interrupted by a retrogression that began late in the previous year and that was punctuated by stormy political developments abroad and a growth of general war fears. The extent of industrial decline is indicated by the *Business Week* index, which fell from 111.9 in 1937 to 86.3 in 1938, or 23 per cent. Factory employment decreased about in the same ratio. National income also was reduced, but only 6 per cent, from an estimated 70 billions to 64 billions. Electric power consumption, a sensitive index of activity, went below 1937 but rose to a new high record in November.

Rise in Construction

CONSTRUCTION ACTIVITY increased during 1938 despite the general recession. A gain of 11 per cent was made over 1937 in the face of an alarming drop in private-enterprise construction. Active forces were extension of residential building under pressure of the increasing housing deficiency, and government efforts to stimulate employment and provide relief. The largest gain was made by public construction, while private construction decreased 7 per cent in spite of the growth in housebuilding. The total reached 6½ billions, against 5.9 billions in the preceding year; thus construction has not yet passed three-fourths of full activity. Prices of construction materials were considerably lower than in the previous year, while labor costs were higher; in net result construction costs held steady. Bidding by contractors showed active and even aggressive competition at all times. The contracting field derived only moderate benefit from the increase in amount of construction because of the encroachment of work-relief operations on the normal contract-construction field, an encroachment that has gone progressively farther since the creation of the Works Progress Administration.

Factory Building Declines Sharply

SHARP DECLINE in industrial construction is the most significant feature of the 1938 construction record. It followed on the drop in industrial

demand and was intensified by the uncertainty of the outlook, both with regard to governmental social and economic policies and with respect to war possibilities. Factory building fell back to its 1934 level, practically a subsistence or maintenance level, and this abrupt drop was especially severe in its effect because 1937 had brought a boom of industrial construction approaching that of the peak year, 1929. It is timely to recall at this point that early spring of 1935 showed the first significant rise in factory construction from the bottom level of the depression, and that the rise continued and further increased throughout 1936 and the first half of 1937 until checked by the depressant influence of the recession. In less than six months' time this whole recovery gain was wiped out. Now, however, indications give prospect of more active factory building during the current year.

National Defense Enters Picture

WITH THE CLOSE of the year an extensive program of defense construction came under discussion, as the result of fears of possible aggression growing out of foreign wars and political changes combined with an increasing trend toward national self-sufficiency. Building of warships, yards and docks, army posts and fortifications is projected, and unofficial statements have included even a system of defense highways. However the program may develop, it presages added construction activity and increased employment of construction materials and workers.

GOVERNMENT AND CONSTRUCTION

Policies and Legislation

NO HALT to the growth of influence of federal policies and activities on enterprise became apparent during the year, and construction was involved as much as general industry. Regulatory laws and the expanding range of federal construction of improvements exerted their effect on construction. Of most immediate importance was a new PWA program, initiated by Congress in June after the lapse of 1½ years since the close of allocations in the prior program. The National Housing Act was perfected, to cope with the growing deficit in housing by systematic aid to low-income-group homes. Alongside these new activities, the work-relief operations of the Works Progress Administration were maintained and plans were being shaped toward a permanent WPA force-account system. Passage of a federal law to control minimum wages and maximum hours of work in all employment affecting interstate commerce and increased wage control under the public-contracts law were other developments. Flood control in its entirety was taken over by the federal government through an act confirming and extending the 1936 Flood Control Act, but the new legislation has resulted in little new work to date and has raised many questions. The general trend toward federal power development continued during the year.

New PWA Program

TARDILY RECOGNIZING the seriousness of the business recession and the new growth of unemployment, the government early in the year, after attempting to expand credit by reducing bank reserve requirements, inaugurated a third PWA program, with about one billion dollars for grants (at 45 per cent of project cost, on the 1935 rule), which will make possible about two billion dollars' worth of construction. Congress assured intensive application of the fund by allowing only six months for project allocations and beginning of construction and 18 months more for completion of work. The results were immediate. The seasoned PWA organization, with several thousand approved projects on file and with a rush of new project applications by cities and states coming in, worked with remarkable speed and by the end of the year had allocated the full fund to about 7,000 projects. A large part of the total cost of the projects should be paid out during 1939, or well over a billion dollars. No data are available to show how much of this work would have gone forward without PWA aid.

Wage-Hour Act

ADMINISTRATION of the Wage-Hour Act, effective in the last quarter of the year, caused much confusion because of its undefined scope and the latitude given to the Administrator, not uncommon in modern reform legislation. Few administrative decisions had been made by the end of the year, and no legal determination of the scope of the act had been obtained. Further uncertainty was caused by the Administrator's expressed desire to have the act applied universally regardless of the scope intended by Congress. It may develop that contract construction for corporations or individuals engaged in interstate commerce and also the work of engineers who design and supervise operations on such projects or beyond state lines will come under the

act. The working of the law to date suggests that its scope will be uncertain for a long time, and that it will therefore exert a certain measure of restraint on the natural growth of construction.

TVA in Trouble

DISRUPTION of the Tennessee Valley organization was the outstanding event of the year in the history of the federal government's developmental and power-generating activities. In March, after bitter dissension among the three directors and charges of questionable procedure in land purchases, power sales and phosphate-deposit acquisition, the President dismissed the respected chairman, Arthur E. Morgan, although the basic TVA Act made board members removable by Congress alone (except for political activity). A Congressional committee inquiry failed to clarify the situation, but, aside from testimony on exorbitant claims and on subsidies to cities and colleges, it revealed seriously unbusinesslike methods in establishing power rates. The TVA system lost acceptance as a "power yardstick" undertaking, and public faith in its administrative soundness and integrity was weakened. Danger to the valley from incompetent management of combined flood-control and power reservoirs was also brought to light.

NATURAL EVENTS

Year Fairly Normal

NATURE was favorable to man's needs during 1938, with a few notable exceptions. Temperature and rainfall were about normal. The long drought sequence that parched the Great Plains for some years and carried wind-borne dust eastward to the Atlantic had apparently ended. Two great floods claimed attention, in Southwest and Northeast respectively. The former centered in the mountains along the north rim of the Los Angeles coastal strip and with exceptionally intense rainfall gave a striking demonstration of the severity of the local flood hazard. The New England floods resulted from the rare phenomenon of a tropical hurricane that swept far north and crossed eastern Long Island into the mainland, where it did unprecedented destruction along the shore and flooded rivers to stages rivaling or exceeding those of the great March flood of 1936. In addition to these outstanding events some tornado destruction was recorded in the Southeast, though the year on the whole was by no means a pronounced tornado year.

Flood Control Test

CONCENTRATED downpours, as high as 30 in. in 24 hrs. in the mountains, marked the Southern California floods of March as unusually severe. A disaster like that of New Year's Day, 1934, would doubtless have been repeated but for the series of debris basins built since that time along the upper courses of the mountain washes. The flood provided the first test of these and other elements of the flood-control work on the Los Angeles and San Gabriel rivers, indicating the work to be generally adequate.

The September Hurricane

GREAT LOSS of life and property in the hurricane storm of Sept. 21 gives this event prominent rank in storm history. It caused some 400 deaths, vast destruction of shore property, interrupted New York-to-Boston rail connection for a week, and in addition caused high floods in most western New England rivers. The Connecticut, passed all prior stage and discharge records except that of 1936, while minor rivers rose to heights unprecedented since the beginning of systematic records. Because the floods followed close after those of 1936, prior inferences as to flood frequency were upset, and the flood hazard of the region was shown to be greater than previously believed. The southern coast of New England experienced tidal rises up to 10 ft., topped by high storm waves that destroyed houses, docks and other shore works.

WATER USE AND FLOOD CONTROL

Hydraulic Works Make History

COMPLETION of several great hydraulic works and the initiation of other large enterprises distinguish 1938 history. In the Boulder Dam system, Imperial Dam for diversion of water into the All-American Canal in replacement of the Laguna Dam was completed, and the canal was filled with water. Construction was begun on the Coachella branch, to carry water to the agricultural area north of Salton Sea. San Jacinto Tunnel of the Colorado Aqueduct to the Southern California coastal communities, most difficult construction problem of the whole aqueduct, was finally holed through, after 6 years of continuous fight against heavy water flows. Also Shasta Dam of the Central Valley project was begun, and in the Rockies work started on the

Big Thompson trans-mountain diversion from the headwaters of the Colorado to the farmlands east of the front range near Denver. Still farther east the Muskingum system of flood-control dams was put into service. New York began tunneling operations on its 90-mile Delaware Aqueduct, deep rock tunnel for its full length. Mississippi River flood-control operations have entered on their second 10-year program. Flood control along the Ohio progressed slowly but work began actively on the Allegheny River and upper Susquehanna reservoirs. Elsewhere flood control largely marked time.

Progress on the Mississippi

FEW SKEPTICS now remain among the many who questioned the value of cut-offs as a means for greatly reducing flood damage along the lower Mississippi River. Fifteen cut-offs are now open and slowly enlarging to carrying the full river flow. In the great flood of 1937 the fourteen then partly opened reduced flood stages from 9 to 12 ft. at Arkansas City at the upper end of the section where the cut-offs had been made. With this experience as a background, the Mississippi River Commission engineers now predict that further raising of levees and the construction of overbank floodways, as called for in the earlier flood control plans, can now be eliminated at a saving of many millions of dollars; at the same time a much shorter and better navigable channel is produced.

Earth Dam Troubles

A SLIDE or slump involving an estimated 8 million cubic yards interrupted progress of the Fort Peck navigation storage dam on the Missouri River in eastern Montana in October. Work on this hundred-million-yard hydraulic fill structure was nearing the crest and pumping was going on at full rate to top out the dam by the middle of November, to avoid carrying the pumping plant through the winter. The slump began at the east end of the dam, near the gate shafts of the outlet tunnel but extension to the west was stopped by a berm or toe reinforcement that had been provided along the middle section of the upstream toe for extra protection of the river-channel section. The slump resembled earlier slumps in other hydraulic-fill dam construction, but final determination of causes and method of reconstruction had not been reached by the close of the year. It is expected that a greatly flattened section will be used. A different type of failure, namely crushing out of the foundation, which destroyed the 90-ft. Marshall Creek Dam near Kansas City late in the previous year, led to carrying out unusually elaborate and costly reconstruction, involving excavation of all the soft layers in the subsoil under the dam; the work is still in progress.

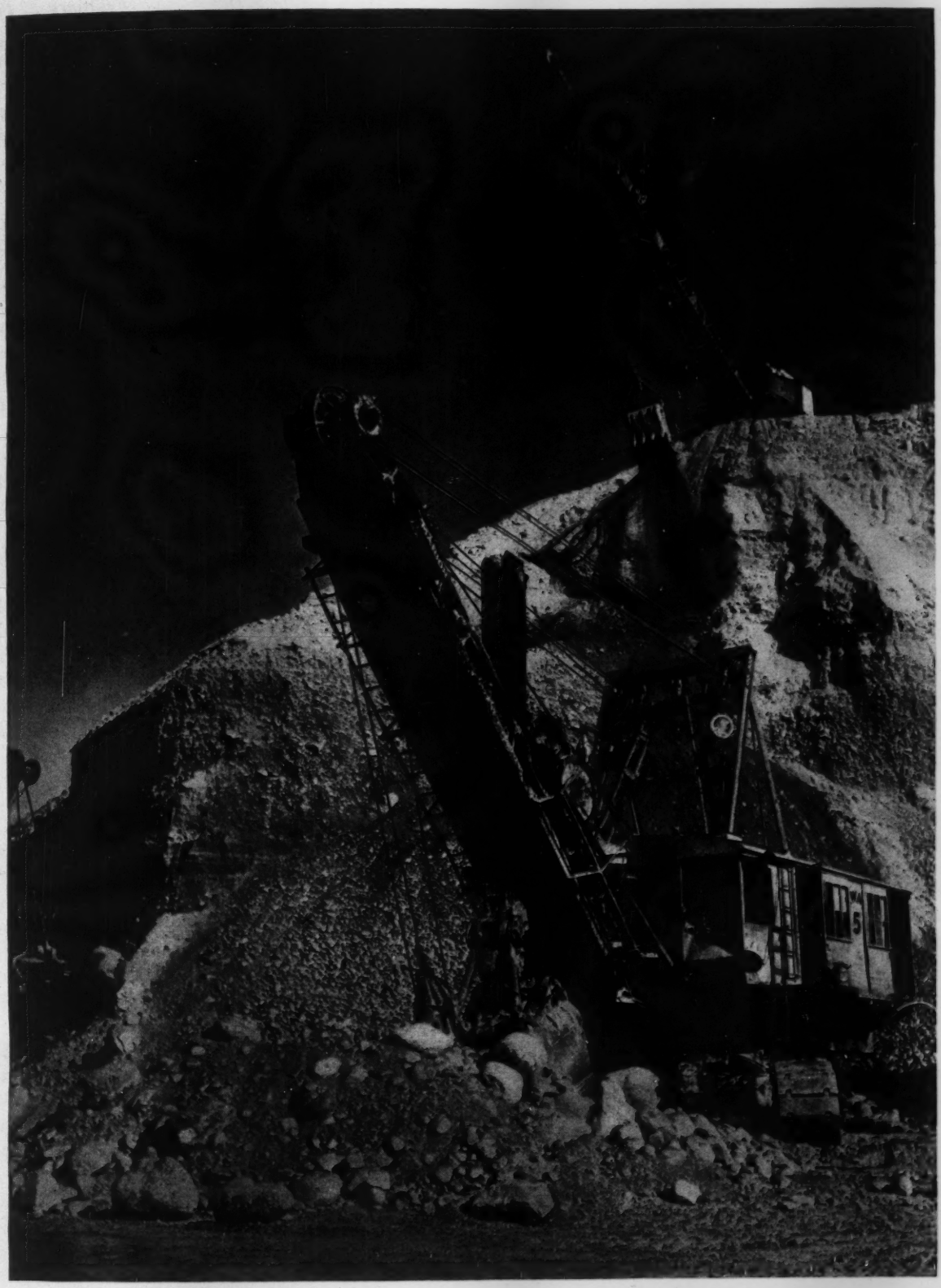
Reclamation Active

IRRIGATION development in the West under the Reclamation Bureau is continuing at the abnormally high level reached through reemployment allocations in the depression emergency. Current construction is at a rate of more than 50 million dollars a year, in continuing and completing the numerous large projects begun during the emergency. As the larger part of the work is financed by general treasury funds, the significance of the reclamation fund, which previously financed all the operations, has largely disappeared. Demand for new agricultural areas in the West has been intensified by the westward migration of thousands of families who abandoned farming in the Great Plains drought region. New phases of reclamation procedure are the construction of some works by work-relief labor without charge to the land owners, proposals to allocate part of the cost of irrigation storage to general tax revenues as flood-control expenditure, and plans to extend small-scale irrigation eastward into the Great Plains by work-relief construction. Water districts are being organized in the Columbia Basin area, and agreements for land sales under the anti-speculation law are being drafted. A broad scheme of progressive development of the million-acre project is under consideration.

TRANSPORTATION

Government and Roads

ACTION BY CONGRESS to continue substantial federal aid to roadbuilding in the face of administration opposition settled for the time being the danger of curtailed construction. Another promising move to continue adequate financing has been the restriction put on government in states by popular vote against diversion of road users' tax money. Sentiment favoring state control seems likely to develop into action before long in more states of the South but it is not actively present over the nation. Persistence of government belief that highway administration is a political plum was convincingly evident in the pre-election talks of candidates for state office and the incoming administra-



Cutting down a great gravel bank to produce the millions of yards of aggregate needed for Grand Coulee Dam.

tions generally acted in strict accordance with this belief by firing highway engineers and putting new men in their places.

Planning From Surveys

THE COUNTRY-WIDE SURVEY of road mileages, types and condition, begun two years ago, which includes a census of traffic and sources of income, has drawn well toward completion in 1938. As states have assembled the figures for easy analysis, definite use in planning is being made of the information gained, which in many states is the first exact information ever possessed of road requirements based on transport needs. Conviction by state highway administrations of the value of the survey has mounted and general action is beginning to capitalize on it.

Arterial Highways

PLANS for arterial roads to traverse the country from boundary to boundary received increasing popular and legislative attention. Congress early in 1938 authorized the Bureau of Public Roads to report on the economic justification and engineering practicability of a nation-wide system of toll roads; the report is pending. New York state has plans for an across-state express road; another from New York City to Washington is being powerfully sponsored. Meanwhile Pennsylvania began construction of a 161-mi. toll express road from the outskirts of Harrisburg to the outskirts of Pittsburgh. From another angle, notable progress was made in the development of new access roads to cities and in the extension of metropolitan district parkways. Merely to list the enlarged city entrances and parkways would carry the record beyond reasonable space.

Road Design

THE TREND toward design for higher speeds so evident in 1937 continued during 1938. Wider traffic lanes, separating strips on four-lane roads, flatter curves and longer sight distances are being widely sought. Outside the surfaced travelway, shoulders are being made flatter and ditches wider and shallower. The rounding of backslopes and the streamlining of profiles became general practice. The design of pavement underwent little change; concrete is generally reinforced, and thickened edges prevail, while joint construction is still an unsettled question. In the higher-type bituminous surfaces, advance was confined largely to refined technique in designing bitumen and aggregate mixtures. The boldest experimental work of the year may perhaps be credited to brick road-builders. Further trial with longitudinally laid brick was undertaken; a return was made on one important road to brick laid on green concrete with a cement-grout joint filler, and a test road of reinforced brick was constructed.

Earth Roads

EARTH ROADBUILDING recorded definite progress in 1938. Earth scientifically combined and processed until it is stable and enduringly smooth reached unquestionable acceptance as a surfacing material when covered with a thin wearing and waterproofing bituminous carpet. This development is an outgrowth of the great extension of interest in soils mechanics. Commonly known as base stabilization, the treatment of local soils has taken two directions: mechanical grading and mixing of friction and binder soils to a stable mixture, and processing the natural soil with an artificial binder. Generally the practice followed is determined by the character of the soil that is locally available. Practice is most definite in stabilization by mixing or grading; processing with cement, bitumen and other binders is largely experimental both in theory and practice, but uncertain points are being gradually cleared up and reliable procedures developed.

Road Traffic Control

THREE TRAFFIC-CONTROL TRENDS were particularly noticeable in 1938: (1) Educational institutions recognized that traffic engineering has come to stay and an increasing number installed courses to cover this specialty; (2) traffic engineering received recognition in municipalities, as evidenced by the increasing number of departments of traffic engineering, and (3) operators turned to the drafting room and instructed designers as to the deficiencies of existing facilities and the essentials of new projects. In consequence more attention was paid to lane and grade separations, wide shoulders and reduced grades on separation projects in the interests of safety and traffic-handling efficiency.

The Parking Problem

NO PROBLEM of traffic control in city streets remained farther from solution in 1938 than parking. And certainly no proposed solution received more newspaper attention than the use of parking meters. The parking problem is still unsolved. About 100 cities are using parking meters to control traffic congestion in business districts, according to a

report by the International City Managers' Association. Parking meters have been upheld in Oklahoma, California, Florida, Massachusetts and Texas. Alabama courts declared them illegal in two cases.

Bigger Airports

DESPITE millions of WPA dollars spent on the nation's airports, realization has come that they are not adequate for the future because of the constant increase in size and speed of aircraft. Municipal authorities during the year went on record as being unable to finance further improvement in the face of such uncertainty; they also urged the federal government to establish a system of federal aid to city airports patterned after that provided for shipping in seacoast harbors. A Civil Aeronautics Authority, set up by the federal government to integrate federal activities, put airports on its list of problems for which some sort of long-range policy must be formulated.

Waterways

LITTLE WORK remains to be done to complete the 9-ft. channel development on the Ohio River; work on the Mississippi River canalization from the mouth of the Missouri to Minneapolis was about 90 per cent complete at the end of the year, with 9-ft. channel available over most of the 663 miles. Creation of a 6-ft. navigable channel at least 200 ft. wide in the Missouri from the mouth to Sioux City, a distance of about 800 miles, through the use of permeable dikes and bank revetment, is about 90 per cent complete as far as Rulo, Neb., about 70 per cent to Omaha and about 45 per cent above that point.

Little Railroad Construction

RAILROADS made little progress during the year toward getting back on a sound operating basis and got no help from Congress. As a result new construction, other than that involved in grade separation work financed by the federal government, was confined largely to that required to move railway lines out of reservoirs behind new dams. According to the *Railway Age* compilation, only 38 miles of new lines were built, making 1938 second only to 1934 as a year of low record. A potential reservoir of new construction is filling up in this field, waiting only on an improvement in railroad net income. Railroad maintenance expenditures continued at about half the pre-depression level, but this does not indicate a corresponding deterioration of plant because maintenance needs decline with a decline in volume of traffic and the rails and ties now in use have a longer life than those of earlier years.

Rapid Transit

THE YEAR 1938 was notable in rapid transit history as marking the start of work on the long planned subway system for Chicago and the end of New York's Sixth Avenue Elevated Ry. The new Sixth Avenue subway line is making steady progress. New York is also engaged in further extensions of the city-owned subway in Brooklyn and Queens. Minor extensions have been made to the Boston subways.

Vehicle Tunnels

EARLY IN THE YEAR the Port of New York Authority postponed indefinitely the letting of additional contracts for completion of the second tube of the Lincoln Tunnel under the Hudson River because traffic in the first tube, which was opened to traffic in December 1937, was far below expectations, probably due to lack of adequate approaches in New Jersey. Work on the driving and lining contract that had been let was continued. On the opposite side of Manhattan Island work on the Queens-Midtown tunnel under the East River was delayed by flooding of one tube but was not seriously set back.

CONSTRUCTION PROBLEMS

Ingenious Construction

THE ART OF CONSTRUCTION continually advances. Rare indeed is the modern construction job, large or small, that does not contribute something in the way of new methods, new application and use of equipment or a clever time-saving kink. It may be only a high-rib expanded mesh sidewalk form for a St. Lawrence River bridge, a new soil sampler on a western dam, or it may be the world's biggest belt conveyor at Grand Coulee. One 1938 case was the use of tailor-made sheetpile cofferdams cut to the contour of the river bed on the Deer Isle bridge.

Deep Shaftsinking

SHAFTSINKING in rock reached its highest development on the Delaware River aqueduct for New York's new water supply. Here, in sinking 30

shafts up to 1,550 ft. deep, the engineers and contractors improved the prosaic routine of drilling, blasting, mucking out and placing concrete. New ideas in advance grouting to seal off water flows, unusual pump hook-ups in tandem, heavy headframes and hoisting equipment and new types of collapsible forms are some of the contributions made to the art of shaftsinking. Now, with shaft work out of the way, equally energetic attack on rock tunneling has begun.

San Jacinto Holed Through

HOLING THROUGH of the San Jacinto tunnel on Nov. 19 marked the climax to the most difficult piece of hard-rock tunneling ever encountered in this country. Unprecedented water flows, faults and stretches of bad ground, failure of the original contractor to make satisfactory progress, late driving of the Lawrence adit and necessary changes in alignment all combined to harass the engineers in completing this key tunnel in the Colorado River aqueduct. Water caused the most trouble; at times more than 40,000 g.p.m. were pumped out of the two shafts. New methods of advance grouting behind bulkheads were developed.

BRIDGES AND BUILDINGS

Bridge Design Trends

THE YEAR IN BRIDGES was not as notable as some previous ones, either in outstanding projects or in significant design or construction developments. But it was normal in that important contributions to knowledge and advance were made. A tendency toward wider decks on highway bridges is the rule, the wide deck usually divided by a center island. Rigid frames in both concrete and steel have become as common as were simple spans a decade ago. Only one state out of the forty-eight is reported still to favor simple spans over continuous span layouts. Concrete flat-slab bridges, now that scientific and practicable design procedures are available, are being accepted fast; some have been built with spans up to 45 ft. High curbs and sturdy handrails are getting the universal recognition they deserve for safety's sake; smooth lower rails are found more and more frequently.

Longer Girder Spans

A MAJOR ADVANCE which should be credited to 1938 was the wide acceptance of long continuous plate girder spans. A tendency in this direction has been evident for some time, the spark having been kindled several years ago by the successful use of the deep rolled girder sections in spans up to 100 ft. Beyond such lengths, plate girders are usually more economical and the experience with rolled girders made it natural to think of plate girders in similar continuous span layouts. Gradually span lengths were stepped up to 200 ft. Then, during the past year a span at Topeka was built to 217 ft. Now work has begun on a 220-ft. span at Tallulah Falls, Ga., and on 250-ft. spans at Charleston, W. Va. and Perth Amboy, N. J. This latter bridge, over the Raritan River, will also include eight 200-ft. spans and will provide 135-ft. shipping clearance, a layout which hardly would have been considered suitable for plate girders even a few years ago.

Large Bridges

CANTILEVER AND SUSPENSION bridges, standard types for major crossings, are generally subject only to special isolated refinements, except when a George Washington or Golden Gate span comes along. Yet, several fundamental trends are becoming evident. A desire to make the through cantilever truss of more pleasing appearance is being expressed in curved chord lines that continue unbroken into the anchor spans. The Neches River Bridge in Texas and the Bluewater Bridge in Michigan are examples. In suspension bridges, the Whitestone span of 2300 ft. at New York introduces plate-girder stiffening "trusses", an innovation that is immediately reflected in a 2600-ft. span planned at Tacoma. The Whitestone towers, with only one horizontal strut above the roadway, also mark the climax of a trend to reduce the number of lateral bracing members, begun first by substituting horizontal struts for diagonals and now by reducing these struts to a minimum number. Suspension bridges are also getting more consideration for medium spans, 700 to 800 ft., as in the two Thousand Islands structures.

Toll Bridges Accepted

NEARLY ALL new large public bridges are toll structures, the only notable exception of the year being the Connecticut River Bridge at Middletown. Thus, financing public bridges as self-liquidating projects may be said to be the accepted practice of the times. Whether it will be more successful than on some of the private toll structures of the past decade remains to be seen. However, one public toll structure—the Henry Hudson bridge over Spuyten Duyvil Creek at New York—seems an assured suc-

cess, for, after a year's operation, an upper deck was added in 1938 which immediately doubled the revenues; at a 10-cent toll it is estimated the cost of this bridge will be amortized in ten years instead of the twenty allowed for.

Improving Existing Bridges

NATIONWIDE repair and reconstruction of existing bridges to meet the needs of modern traffic was a feature of the year. Most improvements were in the form of new lightweight decks, although floorbeam, stringer and occasionally truss strengthening was not uncommon. Welding played a prominent role in such work. Open-mesh decks have overcome early prejudice against their use and find frequent application on new as well as reconstruction jobs. The concrete-filled steel-grid and the steel plate deck with asphalt plank wearing surface are other popular types. The most notable bridge reconstruction program involves the long-span East River crossings at New York City, which are being redecked with concrete to improve traction and reduce maintenance; precast filled steel-grid slabs are a feature of the Manhattan Bridge work. Upper roadways have been added to some of the bridges to increase their capacity.

Bridge Failures

SEVERAL BRIDGE FAILURES marred the record of the year. Especially disastrous was the collapse of a plate girder bridge of the Chicago, Milwaukee, St. Paul & Pacific R.R. in Montana, which wrecked a passenger train and took 50 lives; an undermined pier was determined as the cause. The most spectacular failure was that of the Niagara Falls arch, knocked off its abutments by an unprecedented ice jam in the deep rocky gorge which the bridge had spanned for 50 years. Most significant technically was the collapse of a welded Vierendeel truss span in Belgium. Unexpected because the bridge had been in service for some months without sign of distress and because it was similar to several dozen other bridges in the same country, the failure came as a shock to all interested in the structural welding art. A feature of the failure was the brittle character of the breaks, many of which occurred some distance from welds. Consensus of opinion is that the steel used was unsuitable for welding. Despite suggestions that the welding may have been of inferior quality, the failure did not furnish any grounds for condemning welding as it is practiced under the careful control common on important work in this country.

Building Design Trends

FEW DEVELOPMENTS in the building field were important enough to command wide attention. The trend toward universal approval of welding continued, with New York City and Chicago the most important recruits to an already numerous company. A half dozen medium-sized welded buildings were erected in New York City under the new code. In modern welded building work there is a trend toward designs that permit as much welding as possible to be done in the shop. Rigid frames, both concrete and steel, found application in several one-story factory and airport buildings, but no multiple story frames such as are encountered in Europe have appeared. Proficiency in earthquake-resistant designs is being developed on the Pacific Coast with each new building; experience so gained may improve building practices elsewhere.

Changes in Details

WINDOWLESS BUILDINGS with glass block walls continue to multiply; in industrial structures monitors inclosed on all four sides with glass block are finding favor. Better soundproofing of buildings is a trend of the times, drawing on example and experience in the moving picture and radio industries. The extensive construction programs of the New York and San Francisco World Fairs have given opportunity to try many innovations in the use of timber, and some of these, such as exterior plywood inclosures and combination timber-and-steel and timber-and-concrete joints will find application in permanent buildings. So far, the public housing program has hardly progressed far enough to indicate an influence on design, although the Red Hook project in New York City is giving cold-twisted high-strength reinforcing bars and vacuum concrete their initial test in a major structure.

New Public Housing Program

HOUSING by federal subsidy took a new tack in 1938. Previously, limited-dividend companies and the PWA were the beneficiaries of governmental largess; neither proved to be able to achieve low-cost housing. The United States Housing Authority, which inherited the Public Works Administration's mantle of slum clearance housing, has made a better showing as measured by advance estimates and early contracts; at least, New York costs have been forced under $5,000 per living unit while in southern and western cities $2500 costs are not uncommon. The USHA is set up to loan money to municipal housing authorities—90 per

cent of the cost of the project on what amounts to interest-free terms. The cities provide the other 10 per cent. The local authorities plan, build and operate the housing. Thus, 1938 saw some measure of local autonomy introduced into the public housing field. Furthermore, New York State voters approved a constitutional amendment permitting state and municipalities to supplement the federal efforts; the legislature must yet find the necessary funds.

Public Housing Accomplishment

TURNING TO USHA accomplishment of the year, it contracted to loan $321,000,000 for 140 projects in 75 cities; it earmarked $329,000,000 for projects in 123 cities; and it set aside the remainder of the $800,000,000 available, namely, $150,000,000, to pay the 3½ per cent annual subsidy on the above projects. Twelve projects costing $45,000,000 and providing 9000 living units have reached the construction stage; it is estimated that projects providing 75,000 additional units will be begun in 1939 and an equal number in 1940 from the funds now available. Cooperation of the states in enacting housing authority legislation has made this record possible, 33 states now having the necessary statutes. A year ago there were 46 local housing authorities; on Dec. 30, 1938 there were 221. The USHA made an auspicious start on its program in 1938.

Homebuilding

DOLLAR VOLUME of privately financed homebuilding was about 9 per cent ahead of last year, but this record was only made possible by a spurt in the last 6 months of the year, engendered by FHA liberalization of its mortgage insurance plan, permitting lending agencies to make 90 per cent mortgage loans on homes costing less than $6000 and permitting insurance of large-scale rental projects. Such large-scale projects, incidentally, gave a conspicuous account of themselves, nearly $50,000,000 worth being placed under construction. In the small residential field FHA registered an increase of 41 per cent in mortgages accepted for insurance, the total being $650,000,000. It is probable that the design and construction of these new homes is somewhat better than in the 1920's as a result of FHA insistence on minimum standards and inspection. FHA-insured building probably accounted for half of the total volume. An outstanding project, significant because of its size and owner-financing, was begun in the Bronx, New York City, by the Metropolitan Life Insurance Co. It will occupy a 129 acre site, provide for 12,000 to 20,000 families and cost $35,000,000.

RESEARCH

Steel Investigations

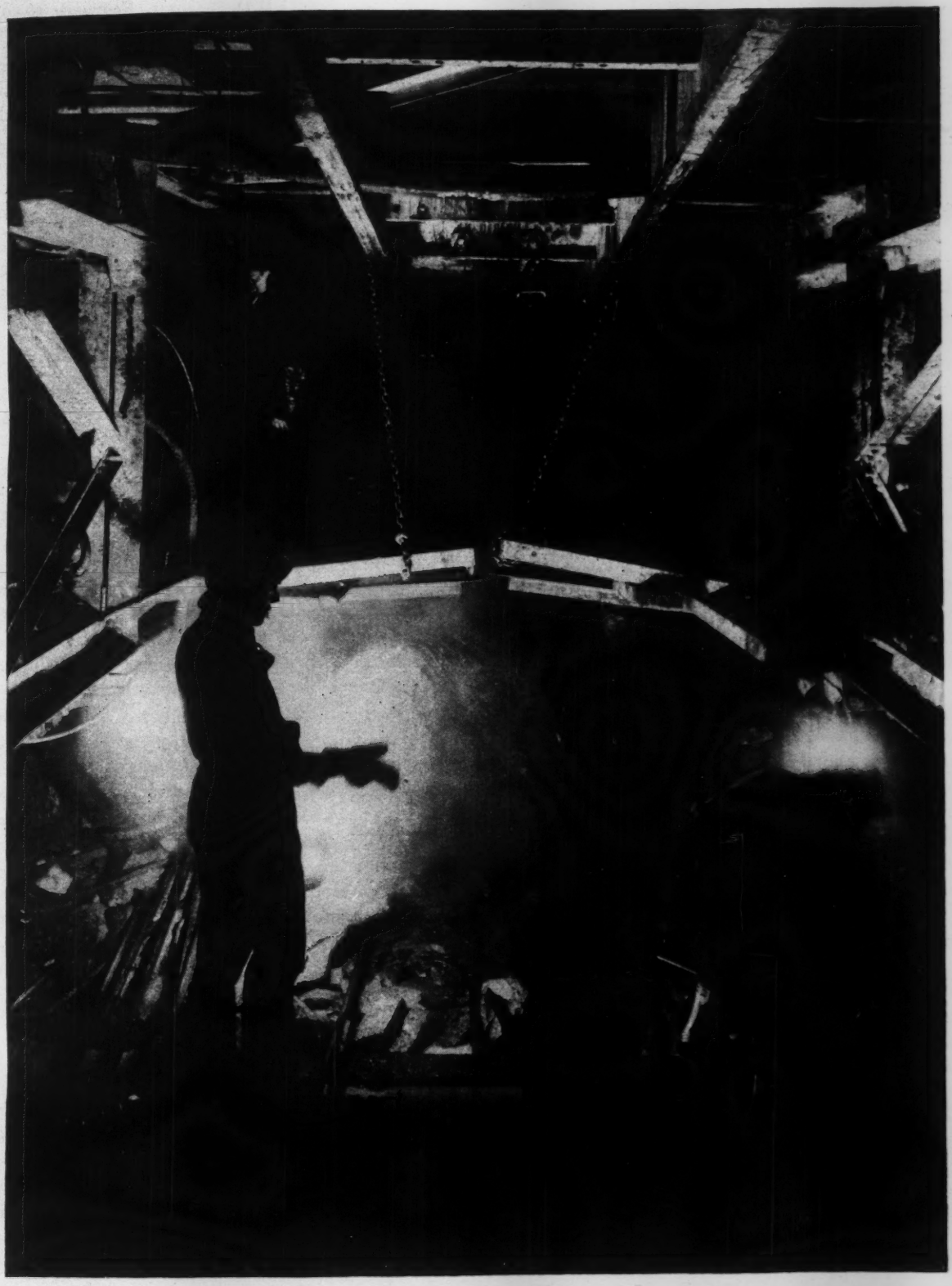
LABORATORY STUDIES looking toward better materials or more scientific application of existing materials were as active as ever, but with fewer reported results than usual. One significant investigation that was completed was the study at the University of California of large riveted joints in tension, from which it is concluded that unwarranted emphasis has been placed on achieving large net sections near the end of joints, that the strength of large joints as well as small is measured by the sum of the rivet strengths, and that transverse spacing of rivets has a much more important bearing on strength than has been conceded in specifications. The monumental study of fatigue in riveted joints at the University of Illinois, reported last year, is being supplemented by tests of the fatigue strength of welded joints. At the University of Wisconsin, new data are being provided for designers interested in metal parts containing abrupt changes in cross section. Welding is the subject of various investigations, three important ones being conducted at Lehigh University on allowable stresses for coated-electrode welds, on load effects on a large-size building frame bent, and on plate girders with inclined stiffeners. Also at Lehigh short columns subjected to bending and direct stress are being investigated for local buckling of flanges. At the Bureau of Standards the tests of full-size rigid-frame knees have yielded important data affecting design practices.

Cement Inactive

DEVELOPMENTS in cement were few and of minor character compared with other years, the only one of note being a change in the definition of normal portland cement to permit the addition of non-harmful admixtures in amounts not exceeding 1 per cent. Puzzolana cements are receiving new attention in the laboratory.

Concrete Reinforcement

CONCRETE RESEARCH as usual was extensive and varied. A revival of interest in bond strength of reinforcing steel was noted, important findings being that bond differs between horizontal and vertical bars owing to differences in effective con-



Men and machines dig another great aqueduct for New York City, tapping the headwaters of the Delaware.

tact surfaces; that delayed vibration is often beneficial to bond; and that while bond working stresses are usually based on compressive strengths, bond strength and compressive strength of concrete are unrelated. At Columbia University and the University of California the effect of type of cement on bond is being studied; while at Lehigh the bond strength of rusted deformed bars is being tested. Also at Lehigh high-yield-point steel reinforcement for concrete beams is now under investigation. Volume change and plastic flow continue to be studied in an effort to reduce cracking in structures; the type of aggregate used was shown to have a major effect on shrinkage of concrete and therefore upon cracking. Low-heat cements have also demonstrated their efficiency in reducing cracking; because of this and because they exhibit a greater plastic flow during the hardening period, they have been used extensively in recent Bureau of Reclamation dams.

Concrete in Structures

IN THE FIELD of concrete structures the most notable work is being carried on at Illinois, where bridge floor slabs are being subjected to concentrated loads to check some of the modern analytical design methods and where two rigid frames of 48-ft. span and a large group of knee frames and structural hinges are being investigated to extend existing design knowledge. The rigid-frame tests indicate that current design practices are safe but suggest the use of shear reinforcing even for small unit shear. At Iowa State College stresses due to wheel loads on flexible pavements are being measured and data on the influence of the thickness of the concrete slab on pressures developed in the subgrade immediately below the load are being assembled. The sustained load tests on concrete columns at the University of Illinois, now in their sixth year, indicate that there is little increase in stress due to plastic flow after the first year.

Soil Mechanics

EXTENSION of both research and practical application is the outstanding development of the past year in soil mechanics. Scarcely an engineering materials laboratory for testing and research is now without its organization and equipment for investigations in soil mechanics. Study is active in engineering schools, public-works departments, commercial laboratories and laboratories set up for individual construction operations. All this is the growth of three or four years, and in 1938 it was exceptional to find a piece of foundation construction, road stabilization or embankment compaction that did not call upon the soil mechanics laboratory for direction and control. In the technique of the science, advance has been mostly in refinement of processes. Most of the fundamental reactions of soil to load, as consolidation, lateral pressure, sliding, etc., have been explored more or less fully by the pioneer investigators, and recent research is directed toward verification and of coordination.

MUNICIPAL PROGRESS

Municipal Money

OUR CITIES had a good year financially, and the picture for 1939 looks promising provided the demand for relief expenditures decreases. Tax collections held their own, municipal bonds found a ready market, and interest rates were low. A survey of 20 large cities showed that interest costs decreased from 3.17 to 2.83 per cent; this reversed the trend of 1937, when the yield rose from 2.62 to 3.17. Among the practices which have contributed to the betterment of city finances is the adoption of long-range budgeting for capital expenditures, refunding of outstanding bonds at lower rates of interest, and construction of projects on a self-liquidating basis; in connection with the latter it should be noted that revenue bond financing of sewerage works is now permitted by legislation enacted in 35 states, and in part in five others. Major cities, with the exception of St. Louis and Philadelphia, entered the new year with improved finances. A deficit of $2,300,000 in St. Louis may lead to curtailment of city services unless new tax sources are tapped. Philadelphia, with a deficit of $21,700,000, is said to be facing the most acute financial crisis in its history.

Public Works

BOTH in spirit and in fact municipalities moved forward during 1938 in an aggressive assault on public-works problems and administration. Temporarily stunned by the depression, cities came back to the never-ending task of rebuilding, largely with aid of WPA labor. The tangible gains are represented in widespread activity on street paving and widening programs, development of park areas and recreational facilities, airport construction, rehabilitation of water supply systems and installation of sewage facilities. Equally important is betterment of attitude in personnel and with it better technical planning and direction of projects. Salaries were restored in most places, merit systems

are becoming more firmly entrenched, in-service training programs are being well attended and the career concept in public service was lifted from the status of wishful thinking.

Sewage Disposal

MARKED by no single outstanding development or trend, progress in sewage disposal advanced along diversified fronts. Mechanization of treatment devices, elutriation of sludge (installations now at Washington, Baltimore, Greensboro and Hartford), sludge incineration, flocculation of raw sewage previous to sedimentation, and the application of alloy steels and other metals for special service requirements in plants, were in the foreground of attention. Many major plants went into operation. New projects centered largely in the construction of facilities for smaller communities. The expenditure of $136,000,000 for sewerage facilities—a new yearly high—indicates the tremendous activity in sanitation. Yet a nation-wide survey made by *Engineering News-Record* showed that the 4,667 plants already built are serving only one-half the urban population in the country. Federal money continued to support the large volume of work being done. But communities are relying also on the sewer rental plan of financing. Veto of a federal stream pollution abatement bill by the President delayed the establishment of a comprehensive policy but did not hinder public demand for stream clean-up, and many states were able to advance local programs.

Refuse Disposal

POPULAR INTEREST indicates that the perfected land-fill method of refuse disposal which was applied on a big scale in New York City during 1938 was the most notable development in the art. Scores of engineers and city officials sought further information about the practice. Detroit adopted land-fill disposal in the latter part of the year when citizens forced the shutdown of new incinerators, which were alleged to be creating a nuisance. In New York the situation was reversed, citizen groups demanding that incineration be used instead of land fills; a grand jury indicted the Commissioner of Sanitation for maintaining a nuisance.

Better Water Service

DEVELOPMENTS in the water supply field during the past year have been pushed steadily forward, but without unusual or startling advances. New sources each year become more inaccessible and expensive, although more essential as populations increase and the demands for better quality become more insistent. Storage both in large impounding reservoirs and in small local elevated units near point of use gives more assurance of dependability. The same factor is involved in the greater care with which conveying conduits bring supplies to distribution systems. Within city limits, systems were being strengthened with new feeders and ties. Generation-old hydrants and valves in many smaller places are being replaced by modern equipment at closer spacing to meet increasing fire demands. Many water departments report highly gratifying results from leak-detection surveys and subsequent repairs. Sale of water by measurement is now generally accepted as the only equitable way in which to market this commodity. In this connection it should be noted that when Chicago obtained a federal grant of $12,000,000 for filters the stipulation was made that the supply be metered.

Detail Problems

NO NEW MATERIALS for water plants were brought out, although the latest thinking in filter design leans toward ceramic materials—witness the new interest in the Wheeler bottom made up of porcelain orifices and spheres. For locations subject to corrosion, erosion and electrolysis the newer alloys are being considered. Welded pipe is appearing in pipe galleries. Plans for larger plants show that many items of little consequence in small plants are being studied with care. The savings effected in Detroit in bypassing the clear well with a part of the effluent direct to the pumps is an instance. All recent plants are equipped for surface wash of the sand. The alarm of past years over the great load that air conditioning would place on water systems tended to decrease. The use of conservation devices, such as cooling towers, has been found to reduce water requirements by as much as 90 per cent. Of note is the turning to a lake supply of both Toledo and Sandusky, the former from the hard, polluted Maumee River and the latter from an equally undesirable shallow bay source. Grand Rapids is to tap Lake Michigan 30 mi. away. Albuquerque is considering a mountain source 52 mi. distant.

Planning and Zoning

CITY PLANNERS had an active year in reorganization of programs, revision of zoning regulations, study of blighted areas, and furtherance of housing programs. The close alliance between financial and physical planning of improvements met with

further recognition during the year, with New York City and San Diego as recent additions to municipalities that placed responsibility for long-time financial programming in the hands of the city planning commission. In New York City the commission submits each year a detailed review of the budget for the following year and a capital improvement program for the ensuing five years. Revision of zoning ordinances in line with research findings and local experiences is under way in many places.

CONSTRUCTION INDUSTRY AFFAIRS

Engineering Employment

EMPLOYMENT of engineers, which fell off somewhat late in 1937, continued below normal during much of 1938 but showed some improvement during the latter part of the year, due in large part to pressure on states and cities to get their PWA projects ready for contracts by the end of the year. However, the frequency of turnover indicates the temporary nature of many of the jobs.

Unions and Engineers

UNIONIZATION of engineers and engineering employees made little gain numerically during 1938. On the other hand gains were made in wider recognition of unions as bargaining agencies for engineering employees, and there are indications that the whole question of unionization of engineering employees is moving toward a more rational basis than existed in the past.

Professional Matters

INTEREST in the professional status of engineers and in their economic and social position as a group, which has been on the increase in recent years, showed a marked gain during the past year. The American Society of Civil Engineers set up a committee on professional objectives to promote active discussion of professional matters and to work for the improvement of the social and economic status of the engineer, and the American Association of Engineers inaugurated a study of ways for improving the economic position of its members and for bettering the relations between employees and employers. From another angle, the Federation of Architects, Engineers, Chemists and Technicians at its annual meeting in December adopted a resolution calling for closer cooperation between the technical unions and the engineering societies on economic questions. Just after the close of the year the American Society of Civil Engineers published schedules of compensation for three grades of engineering employees which if adopted should be of great help in checking the exploitation of young engineers.

Engineers in Canada

IN CANADA the long considered plan for bringing about closer relations between the provincial professional associations of engineers and the Engineering Institute of Canada bore its first fruit in the approval of an agreement setting up reciprocal relationships in Saskatchewan. Under this agreement members of the provincial association automatically become members of the institute in appropriate grades.

Construction Equipment

THE IMPROVED LINES of equipment exhibited at the Cleveland road show a year ago have lived up to expectations and promises in performance. Many units on trial at the show have met with acceptance in the field and are now in regular production. Equipment introduced to the trade throughout the year indicates that the manufacturers are continuing their efforts toward better engineering, greater dependability, more precise and easier control and more pleasing appearance in all lines. Contractors and other users of construction equipment have at their call a greater variety, more useful and more powerful units than ever before.

Labor Relations

CONSTRUCTION LABOR conditions have settled down somewhat following the unionization drive in 1937 to organize heavy engineering work outside of metropolitan areas. Reports indicate that most of the die-hard open-shop contractors found union waters not so bad after making the first plunge. Nearly all of the 1937 agreements were renewed last year without trouble. The heavy contractors have successfully held off making agreements in cases where labor is poorly or loosely organized; dealing with responsible labor groups largely accounts for the success of the organization efforts. In the building trades, jurisdiction disputes remain an exasperating problem, and unreasonable demands and working regulations are causing trouble and needless expense. So far, construction has been little concerned with the labor relations and wage-hour acts, but much construction may soon be brought under the wage-hour act.

Construction Aids Business Recovery

In the face of a sharp drop in business and manufacturing activities last year, construction showed a substantial gain that promises to continue well into 1939. The total of all construction for 1938 is estimated at $6,480,000,000, an increase of 11 per cent over the 1937 volume. In contrast, business activity declined 22 per cent and manufacturing 23 per cent (Fig. 2). Construction, therefore, was a most important factor in the nation's economy last year, substantially checking the decline in general business.

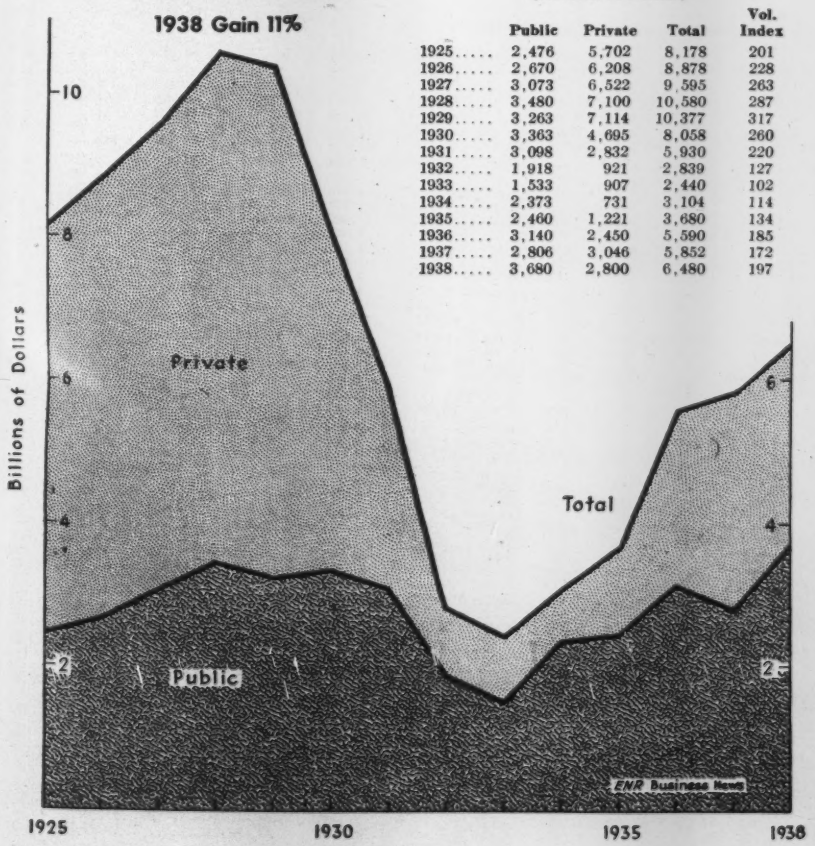
The highest volume of public works on record accounted for construction's strong showing. All public works, estimated at $3,680,000,000, showed a gain of 31 per cent over 1937, but a further breakdown reveals that state and municipal work including most of the PWA loan and grant projects increased 44 per cent, while federal construction gained only 7 per cent.

In private fields, residential building registered a gain of 9 per cent for the year, though private engineering work reflected business conditions, with a loss of 17 per cent. All private construction for the year dropped 7 per cent. Building permits showed little change.

The *ENR* Construction Volume Index, based on the physical volume of engineering construction, averaged 197 for the year, a gain of 14½ per cent. This index is shown in Table I, along with the estimated totals of public and private construction since 1925.

Construction employment has fallen off slightly from the 1936 peak, according to the N.I.C.B. index (Fig. 2). Heavy contract awards late in 1938 have not yet affected employment. Cost of construction averaged slightly higher in 1938 than for the previous year, but closed lower than early year levels.

1. ESTIMATED TOTAL CONSTRUCTION



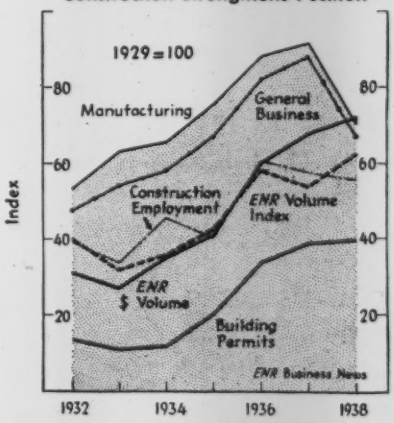
I — ESTIMATE OF ALL CONSTRUCTION IN THE UNITED STATES

(Millions of Dollars)

	Public	Private	Total	Vol. Index
1925.....	2,476	5,702	8,178	201
1926.....	2,670	6,208	8,878	228
1927.....	3,073	6,522	9,595	263
1928.....	3,480	7,100	10,580	287
1929.....	3,263	7,114	10,377	317
1930.....	3,363	4,695	8,058	260
1931.....	3,098	2,832	5,930	220
1932.....	1,918	921	2,839	127
1933.....	1,533	907	2,440	102
1934.....	2,373	731	3,104	114
1935.....	2,460	1,221	3,680	134
1936.....	3,140	2,450	5,590	185
1937.....	2,806	3,046	5,852	172
1938.....	3,680	2,800	6,480	197

2. COMPARATIVE RECOVERY

Construction Strengthens Position



Labor rates in construction increased slightly, but material prices held steady.

Outlook promising

Construction prospects for 1939 are good, for new capital released for construction in 1938 was far above that of 1937. Much of this new money was committed in the rush of contract awards in the final quarter of the year, but considerable funds are still available for the 1939 season. Private and public housing, utilities, and commercial and industrial building are the fields that show promise of increase. Public works will probably hold to or fall slightly below the 1938 level. As a guess, 1939 volume should reach $7,330,000,000, a 13 per cent increase.

On the following seven pages is a more complete analysis of the construction business of 1938, broken down into its various elements.

Construction Activity Analyzed

CONSTRUCTION ACTIVITIES as a whole were briefly discussed on the previous page. The figures given there are estimates only, since accurate and consistent statistics on total construction do not exist. For an analysis of the construction business we turn to figures reported by *Engineering News-Record* on engineering construction work. Since reports only cover projects above a certain minimum amount, and exclude small residential building, the figures total less than half the estimated volume of all construction. Yet, because they are consistent, year after year, they offer a basis for sound analysis of construction activity.

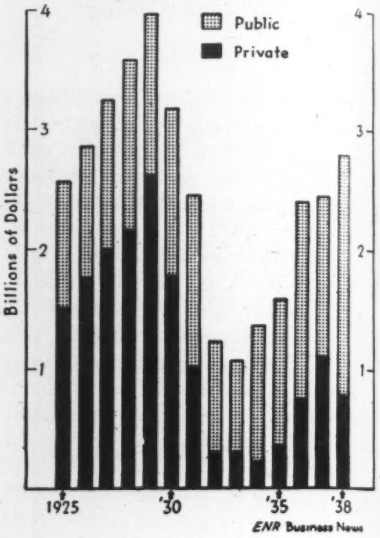
Engineering construction reported last year by *ENR* amount to $2,791,931,000, an increase of 14½ per cent over 1937 and the highest total in eight years. Public works, aggregating $1,991,175,000, was the highest ever reported, increasing 51 per cent over 1937. Private construction, however, dropped 28 per cent below the 1937 level, with a reported volume of $800,756,000, but still above the 1936 total. The trend of both private and public work is shown in Fig. 3.

Distribution by types

A breakdown of reported construction since 1925 by types of work is

3. *ENR* CONSTRUCTION VOLUME

Reported U. S. Total



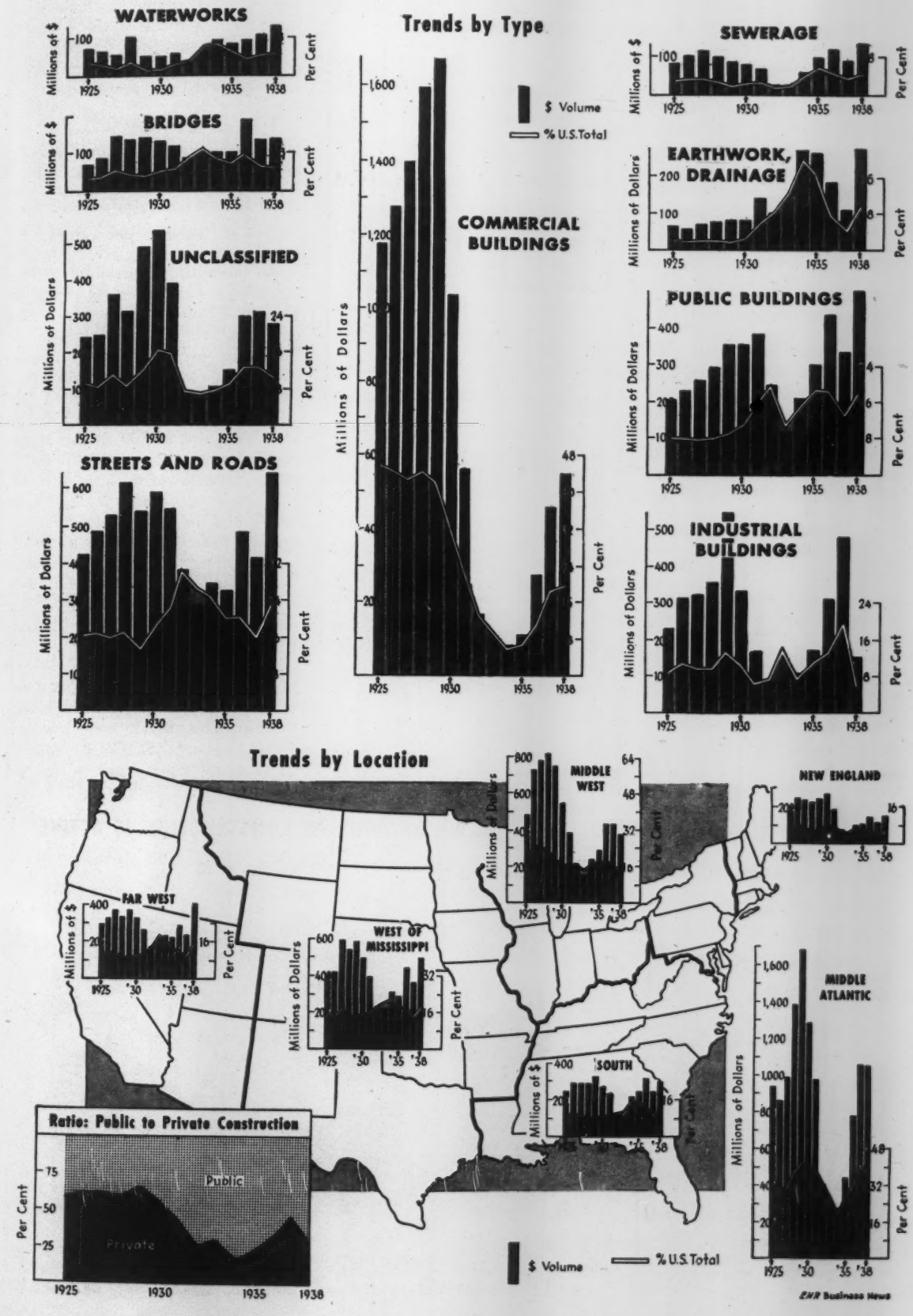
II—ENGINEERING CONSTRUCTION REPORTED IN 1938 BY *ENR*

(Thousands of Dollars)

Minimum contracts reported: Waterworks, excavation, drainage and irrigation, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

States	Water-works	Sewers	Bridges	Earth-works	Streets and Roads	BUILDINGS: Indus-trial	BUILDINGS: Com-mercial	BUILDINGS: Public	BUILDINGS: Un-classified	Federal Gov't Work	All Construction: Private	All Construction: Public	1938 Total	1937 Total	% Gain '38 '37
Me.	966	52	1,515	99	2,317	670	475	1,105	213	967	1,170	6,242	7,412	8,478	−12 0
N. H.	1,193	84	836	175	676	443	.....	3,506	65	662	443	6 535	6,978	5,100	37 0
Vt.	.....	.....	559	48	760	34	.....	1,648	157	514	93	3,113	3,206	4,211	−24 0
Mass.	8,351	4,701	2,343	5,002	8,468	6,509	14,706	13,228	2,177	7,947	21,708	43,777	65,485	44,855	46 0
R. I.	780	587	2,549	94	1,144	548	1,750	2,929	536	1,344	2,408	8,509	10,917	8,107	35 0
Conn.	1,614	3,682	2,387	4,250	10,972	2,674	8,825	15,673	4,850	3,233	13,329	41,598	54,927	41,243	33 0
New Eng.	**12,904**	**9,106**	**10,189**	**9,668**	**24,337**	**10,878**	**25,756**	**38,089**	**7,998**	**14,667**	**39,151**	**109,774**	**148,925**	**111,994**	**33 0**
N. Y.	64,391	26,680	25,606	13,868	57,149	25,994	317,279	95,877	68,355	18,129	365,412	329 787	695,199	615 147	13 0
N. J.	1,877	9,805	7,017	5,127	33,055	4,634	46,424	13,292	19,026	5,967	54 023	86,234	140,257	112,304	25 0
Pa.	3,714	6,610	6,048	7,864	35,570	7,655	26,358	53,927	13,262	9,957	39,058	121,950	161,008	265,865	−39 0
Md.	817	1,879	3,104	607	5,269	8,292	7,945	20,127	2,737	14,867	16,302	34,475	50,777	29,527	72 0
Del.	101	717	28	838	1,528	300	1,368	1,017	21	707	1,668	4,250	5,918	8,856	−33 0
Mid. Atl.	**70,900**	**45,691**	**41,803**	**28,304**	**132,571**	**46,875**	**399,374**	**184,240**	**103,401**	**49,627**	**476,463**	**576,696**	**1,053,159**	**1,058,364**	**−0 5**
Va.	384	307	1,440	2,248	10,209	2,750	1,990	9,440	5,700	10,885	8,619	25,849	34,468	21,440	60 5
W. Va.	471	276	1,609	11	7,833	431	150	3,073	240	645	731	13,363	14,094	7,860	79 0
N. C.	2,913	1,241	1,040	900	17,034	6,484	4,138	6,509	1,293	2,716	10,931	30,621	41,552	25,438	63 0
S. C.	742	415	1,408	921	9,563	226	800	3,076	2,703	2,227	1,464	18,390	19,854	21,040	−6 0
Ga.	1,275	563	1,235	620	6,865	2,240	3,975	4,305	7,649	1,964	13,585	15,142	28,727	18,877	52 0
Fla.	662	571	2,900	1,776	4,727	1,864	6,050	4,992	1,079	3,935	8,547	16,074	24,621	30,498	−19 0
Ala.	534	346	1,704	164	7,188	334	1,675	2,950	3,597	513	3,130	15,362	18,492	14,449	28 0
Miss.	793	30	739	2,575	15,609	322	1,100	1,238	1,492	3,288	2,656	21,242	23,898	23,714	1 0
La.	459	1,832	1,187	6,414	5,740	3,841	1,313	7,873	773	6,605	6,136	23,296	29,432	37,196	−21 0
Ky.	1,185	616	2,185	262	10,518	922	725	12,319	2,155	5,335	3,306	27,581	30,887	22,651	36 0
Tenn.	378	2,862	799	2,925	11,389	938	1,369	8,838	4,876	6,579	3,177	31,197	34,374	19,216	79 0
South.	**9,796**	**9,059**	**16,246**	**18,816**	**106,675**	**20,352**	**23,285**	**64,613**	**31,557**	**44,692**	**62,282**	**238,117**	**300,399**	**242,379**	**24 0**
Ohio.	4,169	10,476	6,762	1,552	46,070	10,659	10,365	19,500	9,983	2,892	26,058	93,478	119,536	130,387	−8 0
Ind.	1,179	3,813	3,301	56	12,600	5,153	4,108	16,151	1,409	3,527	10,167	37,603	47,770	33,007	−44 5
Ill.	3,644	10,874	8,489	9,984	41,562	7,528	16,004	17,880	12,618	10,148	27,480	101,103	128,583	124,830	3 0
Wis.	1,815	4,999	2,450	899	9,537	2,050	2,946	10,973	3,131	822	6,423	37,377	38,800	41,616	−7 0
Mich.	2,610	4,933	1,313	1,787	6,317	4,743	2,860	16,725	6,315	3,216	10,159	37,444	47,603	92,883	−49 0
Mid. West.	**13,417**	**35,095**	**22,315**	**14,278**	**116,086**	**30,133**	**36,283**	**81,279**	**33,456**	**20,605**	**80,287**	**302,005**	**382,292**	**422,723**	**−10 0**
Minn.	1,218	2,057	1,173	94	6,112	2,543	6,250	5,989	4,489	606	12,031	17,894	29,925	31,746	−6 0
Iowa.	1,498	1,981	3,682	1,406	21,907	1,811	1,442	8,289	7,562	2,899	9,774	39,854	49,578	33,987	46 0
Mo.	1,367	6,641	4,455	12,279	14,790	6,940	4,162	13,769	9,691	10,187	14,132	59,962	74,094	67,550	10 0
Ark.	337	111	659	3,729	4,252	905	.....	2,395	824	3,929	1,689	11,533	13,222	6,102	117 0
N. D.	324	386	470	.....	4,336	1,703	375	493	104	67	2,154	6,037	8,191	6,004	36 0
S. D.	28	390	462	38	3,706	1,702	.....	303	130	197	1,702	5,057	6,759	5,345	27 0
Neb.	1,188	2,038	2,653	12,004	11,983	155	450	3,377	4,159	1,106	651	37,356	38,007	28,576	33 0
Kan.	1,838	2,082	1,182	479	17,724	1,120	600	6,313	4,103	1,435	3,369	32,072	35,441	14,584	143 0
Okla.	1,845	1,385	3,334	13,809	26,165	2,225	6,522	6,359	2,300	4,401	9,284	54,660	63,944	20,454	212 0
Tex.	3,748	4,156	8,026	15,039	34,076	12,422	15,110	19,028	9,538	17,921	30,848	90,295	121,143	84,725	43 0
Mont.	276	448	148	1,813	6,069	.....	300	2,370	1,433	1,673	706	12,151	12,857	16,390	−22 0
Wyo.	80	402	214	3,939	4,231	40	.....	791	2,030	5,502	1,863	9,864	11,727	6,231	88 0
Colo.	797	838	375	7,653	6,775	165	125	4,099	2,017	9,922	2,134	20,710	22,844	23,852	−4 0
N. M.	140	1,029	61	594	5,089	180	554	1,746	227	908	821	8,799	9,620	12,872	−25 0
W. of Miss.	**14,684**	**23,944**	**26,894**	**72,886**	**167,215**	**31,911**	**35,890**	**75,321**	**48,607**	**60,753**	**91,188**	**406,244**	**497,352**	**358,418**	**39 0**
Idaho.	351	768	397	848	2,618	40	525	1,856	426	1,775	806	7,023	7,829	10,789	−27 0
Utah.	1,471	684	172	3,085	4,117	499	1,861	3,099	2,628	3,838	4,411	13,205	17,616	8,162	116 0
Ariz.	401	203	93	3,445	8,975	490	.....	2,503	140	5,366	490	15,760	16,250	16,948	−4 0
Nev.	18	.....	527	591	2,649	25	365	418	929	1,284	1,329	4 193	5,522	8,986	−38 5
Wash.	2,957	4,201	7,902	51,053	35,652	2,192	1,510	13,259	21,183	75,290	4,863	135,046	139,909	39,396	255 0
Ore.	1,164	775	881	4,384	12,862	607	790	3,038	12,943	13,288	4,525	32,919	37,444	11,470	227 0
Calif.	3,146	6,549	7,214	60,948	24,105	8,096	24,107	35,335	15,734	76,599	35,041	150,193	185,234	147,994	25 0
Far West	**9,508**	**13,180**	**17,186**	**124,354**	**90,978**	**11,949**	**29,158**	**59,508**	**53,983**	**177,440**	**51,465**	**358,339**	**409,804**	**243,745**	**68 0**
U. S. '38.	131,209	136,075	134,633	268,306	637,862	152,098	549,746	503,000	279,002	367,784	800,756	1,991,175	2,791,931	.....	.....
U. S. '37.	104,449	95,294	133,089	110,353	414,537	477,298	459,969	333,398	309,236	205,588	1,115,866	1,321,757	.....	2,437,623	.....
% Gain '38/'37	26 0	43 0	1 0	144 0	54 0	−68 0	19 0	51 0	−10 0	79 0	−28 0	51 0	.....	.....	14 5
Canada '38.	3,768	3,245	5,949	11,398	14,874	12,511	10,260	11,993	16,549	.....	27,158	63,321	90,479	.....	.....
Canada '37.	3,089	1,448	7,211	17,719	39,601	34,047	5,696	17,979	8,718	.....	42,178	93,330	.....	135,508	−33 0

DISTRIBUTION OF *ENR* REPORTED CONSTRUCTION



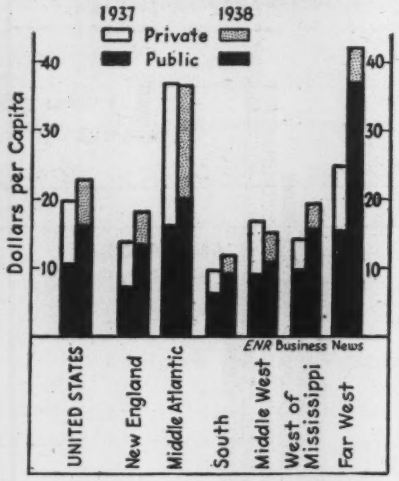
given in the upper part of Fig. 4, in which the ratio of each class of work to the total is also shown. Public buildings at $503,000,000 and streets and roads at $638,000,000 registered new high totals. Besides these two classes, new highs were also noted in waterworks, sewerage, earthwork and waterways, and commercial buildings. Bridge construction showed no change, while industrial building and miscellaneous work declined. Industrial building fared badly last year, amounting to only $152,000,000, about one-third of the 1937 volume.

Geographical distribution

As can be noted in the lower part of Fig. 4, four of the geographical districts in the country showed an increase in construction for 1938, the Middle Atlantic area just barely held its own, and the Middle West registered a decrease. Construction in the seven Far West states last year was the greatest on record, reported at $410,000,000, a gain of 68 per cent over 1937. The Great Plains states also showed a substantial increase, while the South and New England areas recorded lesser gains. The Middle Atlantic section accounted for more than a third of the country's total; the proportion of other districts ranged from 5 per cent in New England to 18 per cent in the Great Plains.

A breakdown of reported construction figures by states, districts and types of work is given in Table II.

5. WHAT EACH OF US SPENT FOR HEAVY CONSTRUCTION



Construction per capita

An interesting distribution of construction expenditures per capita, by classes of work and by districts, is given in Table III. The average expenditure per capita for reported construction in the whole country is $22.75. Geographical ranges are wide, varying from $42.40 in the Far West and $36.80 in the Middle Atlantic districts to $11.81 in the South. By class of work, most money was spent per capita for highways, $5.19, and the least for bridges, sewers and waterworks, $1.03 to $1.11.

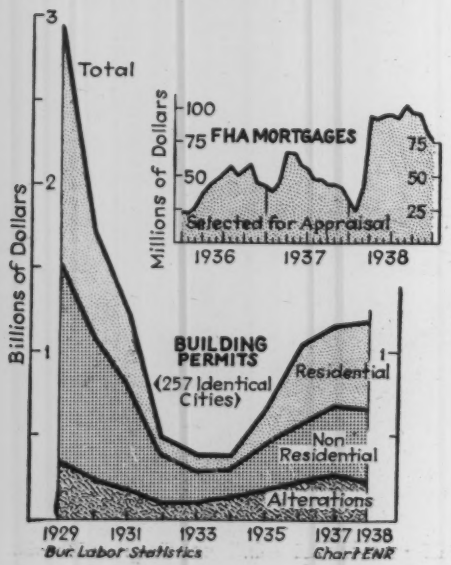
The effect of the large western reclamation and flood control projects is shown in the earthwork and waterways classification, registering $12.88 in the Far West, in contrast with 74c. in the South and 56c. in the Middle West. Highway expenditures per capita were also highest in the Far West, $9.41; were lowest in New England, $2.98. Commercial building rates per capita in the Mid-

III — ENGINEERING CONSTRUCTION PER CAPITA

(*ENR* Reports)

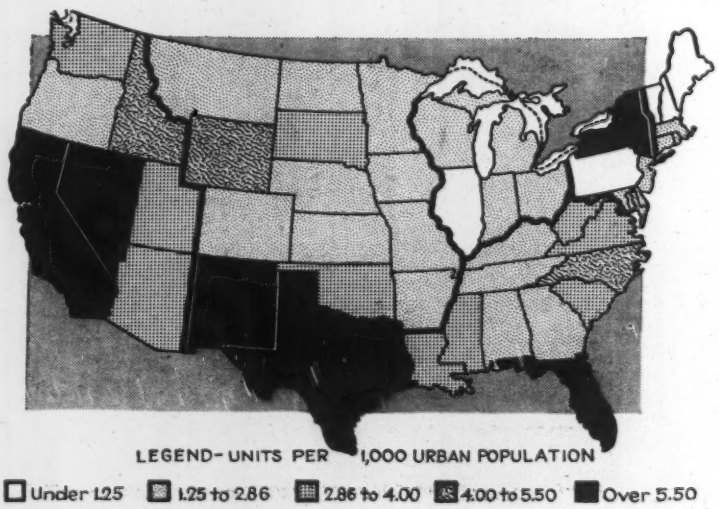
Class of work	New England	Middle Atlantic	South	Middle West	West of Miss.	Far West	U.S. Aver.
Waterworks	$1.58	$2.47	$0.38	$0.53	$0.57	$0.98	$1.07
Sewerage	1.11	1.60	.36	1.39	.94	1.36	1.11
Bridges, Public	1.24	1.27	.61	.88	1.03	1.75	1.03
Earthwork	1.18	.99	.74	.56	2.85	12.88	2.19
Highways	2.98	4.63	4.19	4.59	6.54	9.41	5.19
Pub. Bldgs	4.66	6.45	2.54	3.21	2.94	6.16	4.09
Indl. Bldgs	1.33	1.64	.80	1.19	1.25	1.24	1.24
Comm. Bldgs	3.15	13.93	.92	1.43	1.40	3.02	4.48
Unclassified	.98	3.61	1.24	1.33	1.90	5.58	2.27
Total Public	13.43	20.16	9.36	11.93	15.87	37.08	16.22
Total Private	4.80	16.64	2.44	3.17	3.56	5.32	6.53
Grand Total	**$18.23**	**$36.80**	**$11.81**	**$15.10**	**$19.43**	**$42.40**	**$22.75**

6. RESIDENTIAL BUILDING GAINS



7. WHERE HOUSING CONSTRUCTION IS ACTIVE

1st 9 Months, 1938



dle Atlantic district were $13.93, a figure that far surpasses the next highest rate of $3.15 in New England and the U. S. average of $4.48.

Building permits and housing

Building permits as reported by the U. S. Bureau of Labor Statistics for 257 cities in 1938 total $1,199,000,000, a slight gain over 1937 and the highest since 1931. However, residential building permits in those same cities totaled $544,000,000 last year, gaining 14 per cent (Fig. 6).

Even more encouraging than the rising rate of building permits is the trend of FHA mortgages selected for appraisal. In 1936 they averaged $44,900,000 per month, in 1937 had increased to $49,100,000, but in 1938 almost doubled to an average of $84,200,000 per month.

In the first nine months of 1938 more than 197,000 dwelling units were built in urban areas throughout the country, according to the Bureau of Labor Statistics, an increase of 18 per cent over the corresponding period of 1937. The recent trend is shown by the fact that in the first six months the increase was only 1 per cent, but jumped to 62 per cent in the third quarter. The map, Fig. 7, shows the nation-wide distribution of new housing units.

Construction Financing

MORE NEW CONSTRUCTION MONEY came into the market in 1938 than in any year since 1931. While private financing through purchase of construction securities reached its recovery high, the big increase in new construction capital is from federal loans and grants through the three governmental agencies for financing non-federal construction, RFC, PWA and USHA.

The amount of this new corporate, state and municipal financing through construction securities purchase and federal grant is $2,359,000,000 for 1938. Added to this volume is $317,000,000, federal appropriations for federal construction and $877,000,000 for effective work relief, bringing the recorded total for the year to $3,700,000,000, a 68 per cent gain over 1937.

The largest additional single source of money is the motor vehicle license, fuel and oil tax income, which added some $900,000,000 to construction capital in 1938. Appropriations from treasury funds, payments from current income and unrecorded borrowing make up the balance of the nation's 1938 investment in fixed capital or "real wealth."

The cost of money continued to drop for municipalities to an average yield for high grade bonds of 2.91, the lowest on record. Industry and the utilities, however, had to pay more for the use of money in 1938 than in 1937 but approximately the same rates as prevailed from 1923 to 1929. Yields dropped slightly in the second half of the year.

IV—CORPORATE, STATE AND MUNICIPAL FINANCING

(Millions of Dollars)

	Total Financing Inc. Refunding*			New Productive Capital		
	Corporate	State and Mun.	Total	Corporate	State and Mun.	Total
1925	$4,222	$1,400	$5,622	$1,966	$1,352	$3,318
1926	4,574	1,365	5,939	1,824	1,344	3,168
1927	6,507	1,510	8,017	1,784	1,475	3,259
1928	6,930	1,425	8,345	1,568	1,379	2,947
1929	9,376	1,431	10,807	1,758	1,418	3,176
1930	4,757	1,487	6,244	2,032	1,434	3,466
1931	2,371	1,256	3,627	787	1,235	2,022
1932	643	849	1,484	159	561	720
1933	380	520	900§	292	1,091‡	1,383
1934	490	939	1,429§	77†	1,011‡	1,088
1935	2,267	1,220	3,488§	47†	1,305‡	1,352
1936	4,632	1,117	5,749§	250	698‡	948
1937	2,337	902	3,239§	518†	738‡	1,256
1938	2,076	1,089	3,165§	457†	1,902‡	2,359

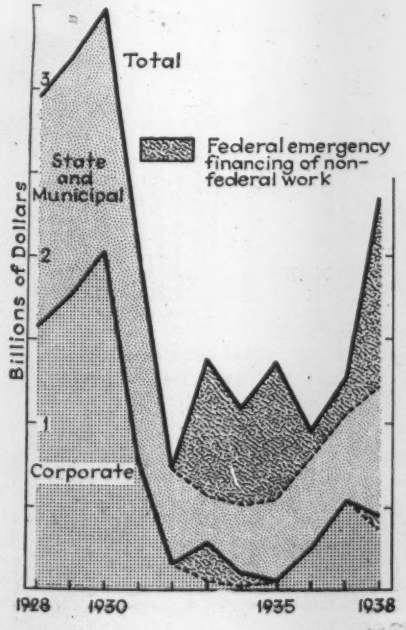
* From Commercial and Financial Chronicle.

§ PWA Financing not included.

† Includes $237,000,000 RFC and PWA loans, '33. $55,000,000, '34. $9,000,000, '35; $807,000, '37; $76,106,000 REA, $4,500,000 RFC loans, '38.

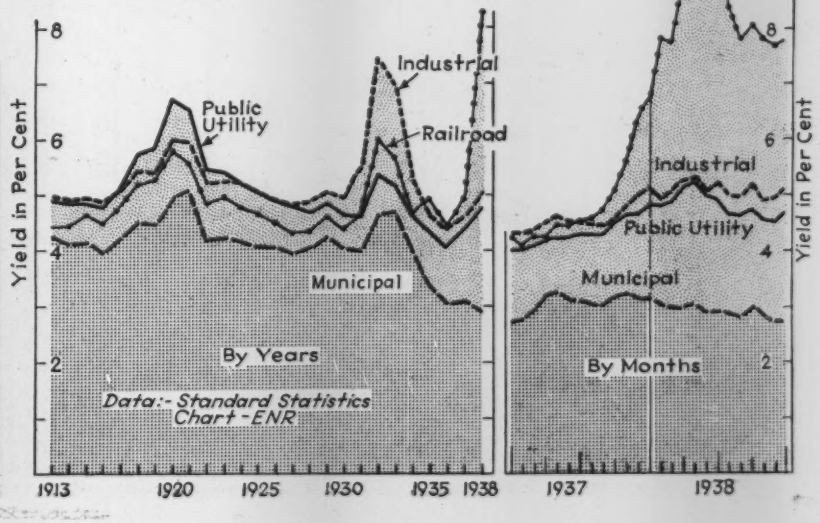
‡ Includes $814,000,000 RFC and PWA loans and grants, '33; $580,000,000, '34; $808,000,000, '35; $164,700,000, '36; $207,000,000, '37. $723,265,000 PWA, $99,844,000 RFC $320,986,000 USHA loans, '38.

8. SOURCE AND VOLUME OF NEW CONSTRUCTION MONEY



9. COST OF FINANCING

Yields of High-Grade Bonds



Employment and Materials

CONSTRUCTION EMPLOYMENT started to fall off during the latter part of 1937, and the downward trend continued well into the spring of 1938. A substantial upturn in employment began last March, continued in most lines to the end of the year, but it was not sufficient to overcome the early year drop. Consequently, all indexes of construction employment for 1938, except that of highway maintenance, are lower than for the previous year, as shown in Fig. 10.

At first glance this seems at variance with the increase in construction volume reported on the preceding pages. However, the construction volume figures, representing contract awards and start of hired labor projects, at the middle of 1938 were below those of the corresponding 1937 period; all of the 1938 increase came in the last half and particularly in the final quarter. Therefore much of the construction activity reported late last year has not yet reached the full employment stage, and a substantial rise in employment is looked for this spring.

Highway employment, both construction and maintenance, was highly seasonal last year. Bad weather in the early spring, coupled with delays in getting projects authorized, dropped employment on the roads to low levels. Resumption of work in the late spring put men on the jobs at a rapid rate and employment rose steadily until October, then again swiftly declined.

Building trades members also found their work fluctuating, though not as severely as highway work. They encountered the early year drop, but enjoyed two spurts of employment, one in late spring and another in late summer. At best, not more than 70 per cent of building trades members were employed at one time in 1938.

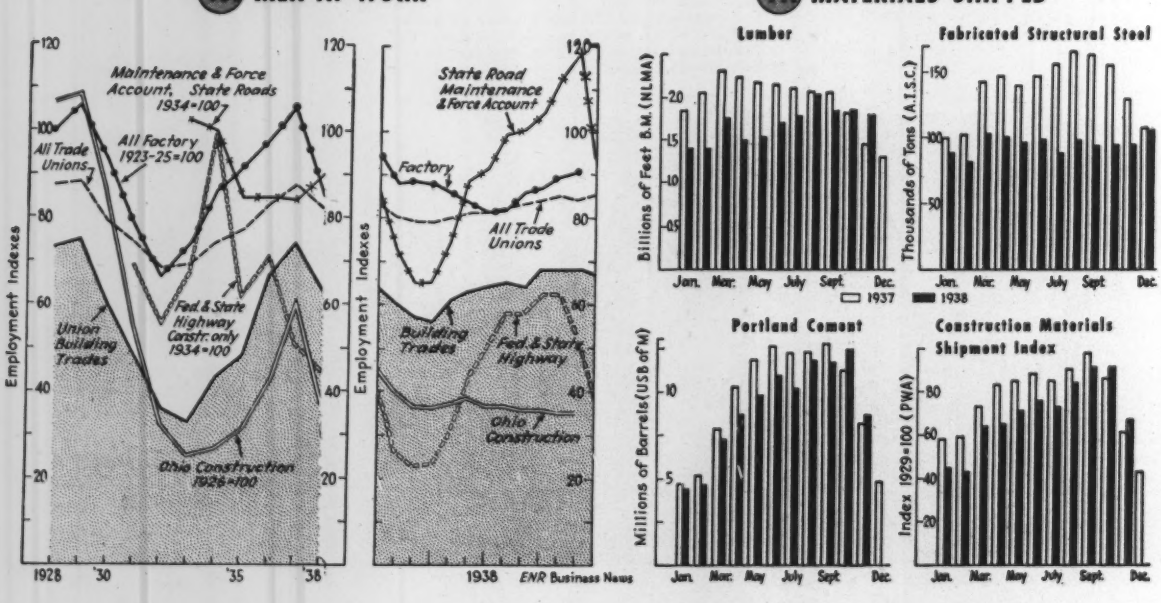
The movement of cement, lumber and fabricated structural steel, three basic construction commodities, was mixed last year in a month-by-month comparison with 1937, as shown in Fig. 11. For the first nine months cement and lumber fell behind 1937 shipments, but showed an increase in the closing months. At no time in 1938 did fabricated steel shipments exceed those of the corresponding months of the previous year, although in December the figures were almost equal. This trend shows that the late 1938 contract awards had not yet affected steel shipments.

The index of shipment of construction materials, compiled by PWA, also shows a lag behind 1937 until October and a gain toward the end of the year. As noted in Table V, prepared roofing and paving brick were the only items out of a list of nine principal construction commodities that did not show a loss for 1938.

V—OUTPUT OF VARIOUS CONSTRUCTION MATERIALS FOR TEN YEAR PERIOD

Item	Basis	Unit	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938*	% Change '37 to '38
Lumber	Production	Millions Bd. ft.	36,886	26,051	16,523	10,824	14,700	15,492	19,539	24,360	24,650	19,470	−21
Cement	Shipments	Thous. Bbl.	169,440	159,558	126,465	80,529	64,086	75,917	74,936	112,566	114,010	107,243	− 6
Steel Ingots	Production	Thous. Tons	54,850	39,595	25,193	13,323	22,594	25,599	33,426	46,807	49,503	27,839	−44
Fabricated Structural Steel	Shipments	Thous. Tons	3,307	2,987	1,812	942	828	1,033	1,095	1,548	1,660	1,146	−31
Fabricated Steel Plate	New Orders	Thous. Tons	639	569	303	162	198	242	258	484	429	277	−35
Explosives	Shipments	Thous. lb.	484,596	424,920	325,440	227,508	249,366	307,380	297,730	378,361	387,805	324,489	−16
Common Brick	Shipments	Millions	.....	.....	.....	.....	.....	637	952	1,720	1,806	1,551	−14
Vit. Paving Brick	Shipments	Thousands	.....	.....	.....	.....	.....	87,216	62,528	96,001	79,716	85,490	+ 7
Prepared Roofing	Shipments	Thous. squares	39,864	27,876	22,560	23,220	24,732	24,000	26,052	32,237	29,942	35,121	+17

* Estimated Totals.



Construction Costs

CONSTRUCTION COSTS declined slowly during the first half of 1938, continuing the drop that started from the all-time high peak of October, 1937, according to the *ENR* Construction Cost Index. In July the index dropped more than four points with a downward change in steel prices; since then fluctuating lumber prices and small wage increases have resulted in a slight rise of the index. The 1938 average of the index was 235.85, as compared with 234.71 for 1937. However, the index last December stood at 234.89, considerably lower than the figure of 241.05 at the end of 1937. This index is based on the cost of cement, lumber, steel and wage rates of common labor.

The *ENR* Building Cost Index, in which skilled labor rates are substituted for those of common labor, likewise showed a slight increase for the year; in 1938 the average was 196.83, as compared with 196.15 for 1937. Here, again, the December figure of 196.07 was below that of 200.45 for the end of 1937.

In both indexes the labor component increased slightly during the year, but was offset by falling material prices. These indexes are shown in Fig. 12, broken down into labor and material cost elements.

A comparison of the *ENR* Construction and Building Cost Indexes with those from three other sources is given in Table VI, revealing a variation in trends. While the other four indexes show 1938 costs higher than 1929, that of the American Appraisal Co. indicates a reverse trend. In all five current costs vary 13 to 50 per cent higher than in 1932.

Labor rate rise checked

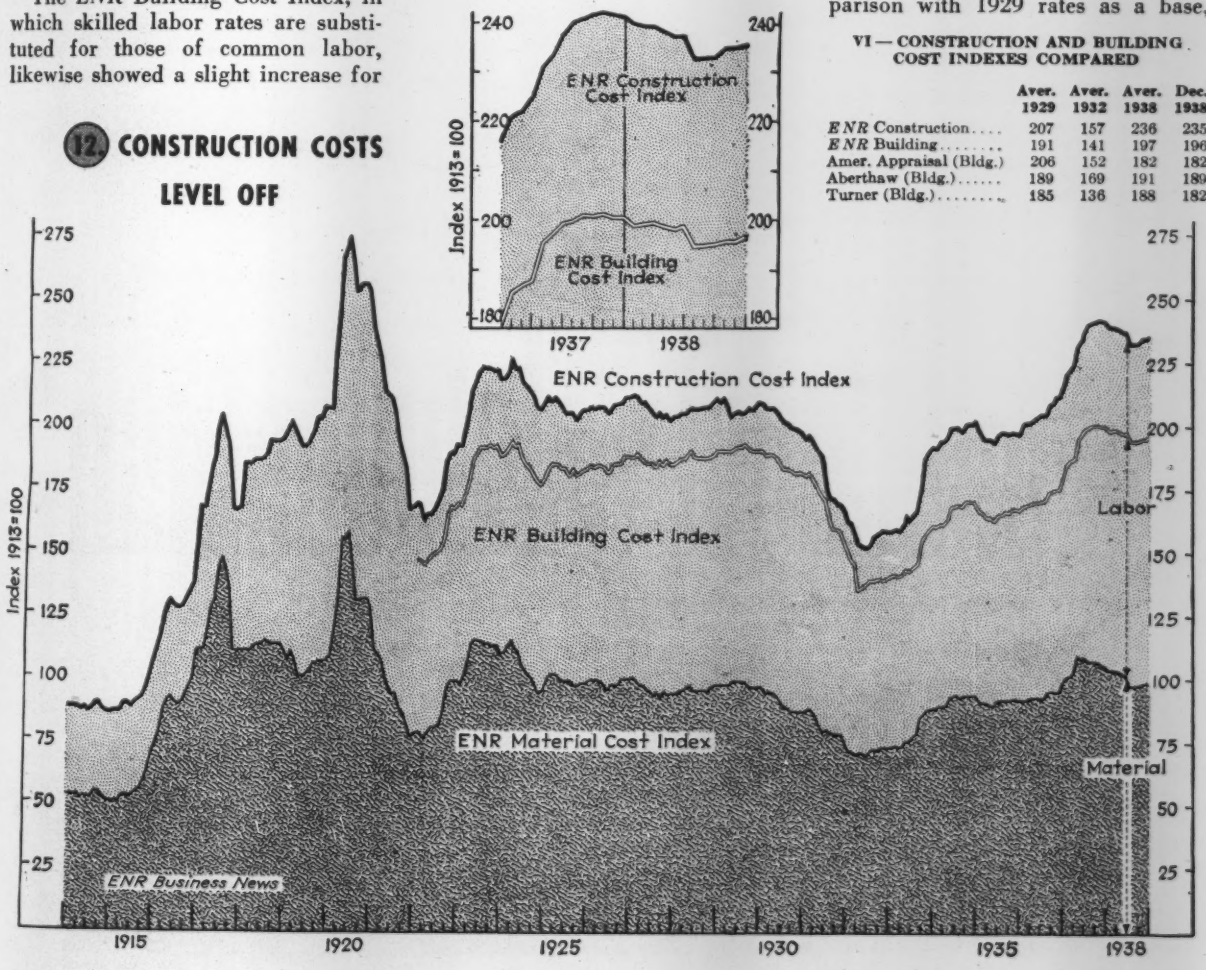
The rise in construction labor rates that has continued unbroken since 1932 was checked last year. Unskilled rates paid in twenty leading cities averaged 67.8c. for 1938, as compared with 64.5c. for 1937, but showed only a fraction of a cent change throughout the year. Skilled wages in the same cities averaged $1.41 for last year against $1.32 for 1937, but likewise showed a slight range for 1938, 3.7c. to be exact. However, both skilled and common rates stood at record high levels at the end of 1938, according to the twenty-city average, $1.427 and 68.2c., respectively.

As shown in Fig. 13, construction wage trends followed closely those of manufacturing in 1938, though the spread between skilled areas in construction and those in manufacturing is slowly widening. In comparison with 1929 rates as a base,

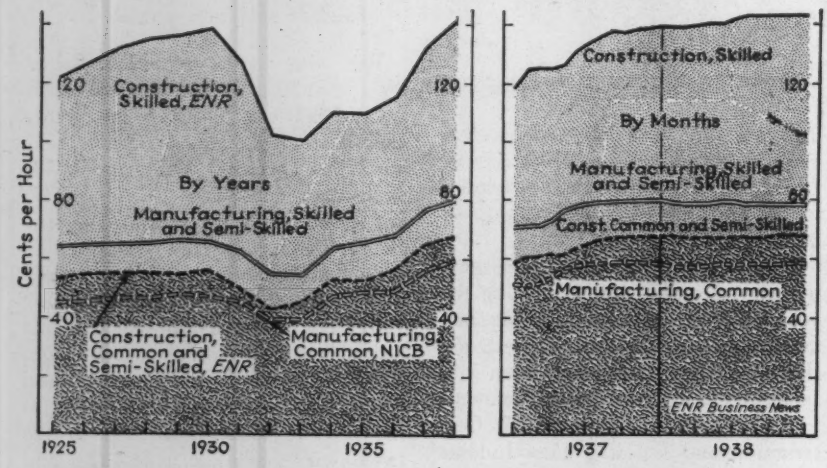
VI — CONSTRUCTION AND BUILDING COST INDEXES COMPARED

	Aver. 1929	Aver. 1932	Aver. 1938	Dec. 1938
ENR Construction	207	157	236	235
ENR Building	191	141	197	196
Amer. Appraisal (Bldg.)	206	152	182	182
Aberthaw (Bldg.)	189	169	191	189
Turner (Bldg.)	185	136	188	182

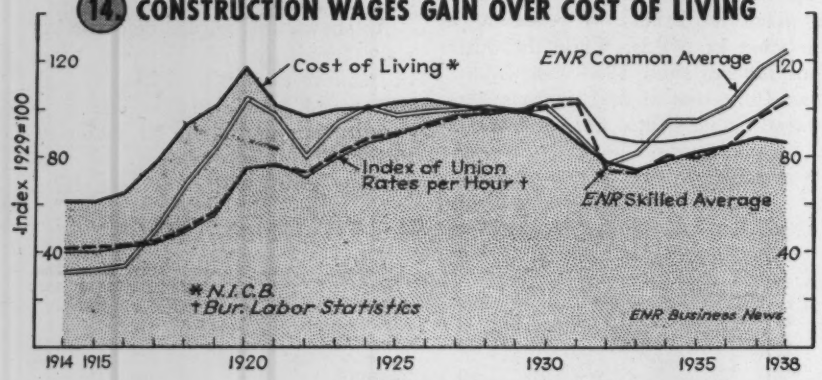
12. CONSTRUCTION COSTS LEVEL OFF



13. RISE IN LABOR RATES CHECKED



14. CONSTRUCTION WAGES GAIN OVER COST OF LIVING



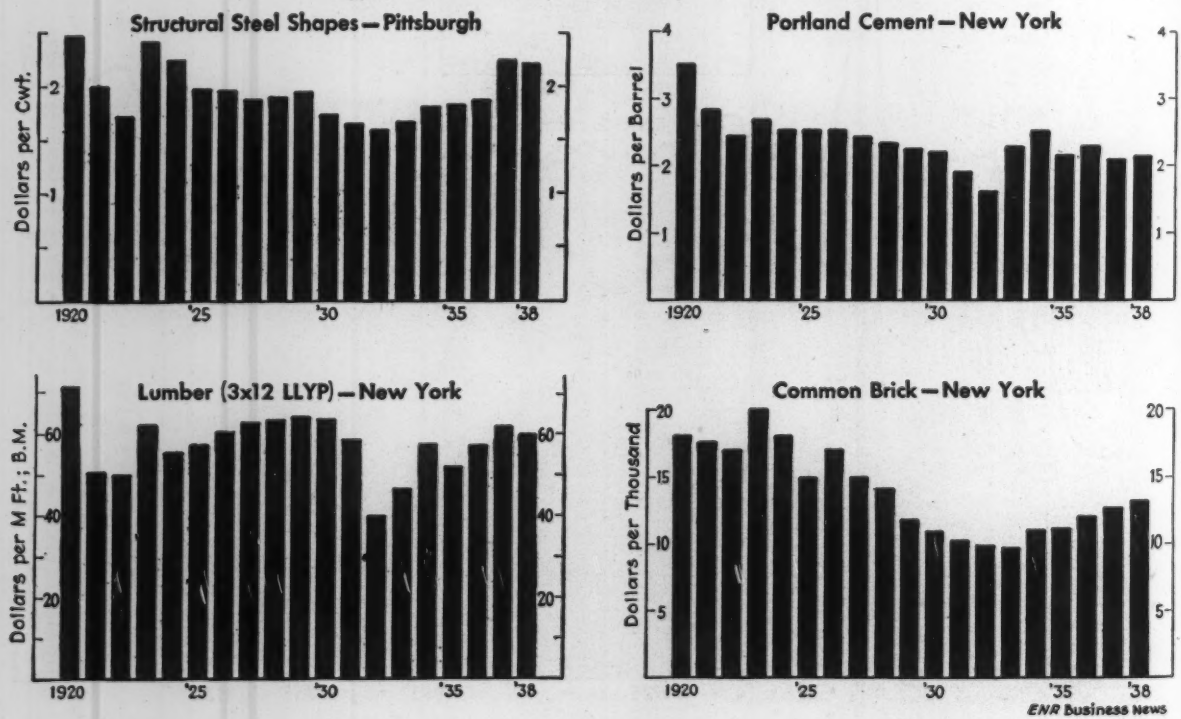
common wages in construction have risen faster than have skilled construction and all union rates, as can be noted in Fig. 14. Construction and union trades wages have risen above the cost of living on a 1929 comparison, gaining considerably in 1938 as living costs in general declined somewhat.

Materials prices

Prices of basic construction commodities held remarkably steady during 1938, as noted in Fig. 15. Structural steel shape prices at Pittsburgh averaged $2.18 for the year, as compared with $2.21 for 1937, due to a drop from $2.25 to $2.10 in July. Lumber fluctuated somewhat, but the average price of $59.33 for 3x12-in. pine at New York shows little change from the 1937 average of $61.50.

Common brick prices at New York dropped from an average of $12.50 in 1937 to $12.10 in 1938. Cement at New York was the only one of the four basic commodities to show a price increase, rising from an average of $2.07 in 1937 to $2.12 in 1938. During the year the price varied from $2.45 at the start to $2.35 in July, $2.70 in August and $2.60 in October.

15. MATERIAL PRICES SHOW LITTLE CHANGE



Major projects pass in review..

This is the record of accomplishment during 1938 on major construction undertakings from coast to coast. In brief form is reported the status of more than 100 projects, each of which is costing not less than one million dollars. The editors of Engineering News-Record *acknowledge with appreciation the generous cooperation of scores of engineers and contractors who provided the data which made possible this inventory of progress.*

WATER SUPPLY

ATLANTA—Pushing ahead on a $1,250,000 pay-as-you-go waterworks improvement program started last year and which will take five years for completion to avoid borrowing funds, Atlanta has added two 32 m.g.d. sedimentation basins and a 40 m.g.d. steam turbine centrifugal pump. In 1939 installation of new pumping equipment and supply mains will be under way and construction will be started on the enlargement of the filter plant. To finance the work 10 per cent of the water revenue is being set aside each year.

COLORADO AQUEDUCT — Extensive work now under way on the distribution system, particularly tunnels and large pipe lines, brings the total length of the Colorado River Aqueduct and distribution system now nearing completion, to 392 miles. Concrete lining in 108 mi. of tunnels has been completed except for about 5 mi. in the San Jacinto tunnel which was holed through Nov. 19. By the end of 1938 the project was 90 per cent completed. First water is expected to arrive at Cajalco reservoir about the middle of 1939.

PARKER DAM—Diversion of the Colorado River around Parker Dam site ceased July 1, 1938 when the second of the two diversion tunnels was plugged. Thereafter, regulated flow passed through large stoney gates on the dam of which there are five. On October 16 water storage began. The dam was built by the U. S. Bureau of Reclamation for the Metropolitan Water District of Southern California.

MONO BASIN—Headings were advanced 15,794 ft. in 1938 in the 11.3-mi. Mono Craters tunnel which is being driven to divert 140 sec.-ft. of water from Mono Basin streams into the Los Angeles Aqueduct. Only 3,807 ft. of the tunnel remained to be excavated on Nov. 25, 1938. At that time about 33 per cent of the concrete lining had been placed.

PROVIDENCE—Extensions and improvements to the Providence, R. I., water supply system costing $1,400,000 were started under the new PWA program. The coagulation basins are to be lined with concrete, and to the purification plant will be added four more filters, new control and indicating instruments and motorized valves to replace those now hydraulically operated.

LOUISVILLE—Early in 1939 the flood protection work undertaken by the Louisville Water Co. will be completed. The dry well pump pit building has been protected by raising the windows and steel bulkhead doors. Two 30-m.g.d. pumps with long vertical shafts are being installed with motors and controls 10 ft. higher than the 1937 flood crest. Other improvements completed involve a rearrangement of coagulation basins from three double-pass basins to six single-pass basins with new flocculators.

LITTLE ROCK—The new $3,200,000 water supply project for Little Rock, Ark., comprising a 14,000 m.g.d. reservoir, 32½ mile concrete pipeline, and filter plant went into operation in May.

CINCINNATI—One of the largest softening plants in the world, 200 m.g.d. capacity, was completed by the city in 1938, at a cost of $3,300,000.

HOUSTON—The $7,000,000 water supply improvement program laid down by consultants last year involves expansion of the existing well supply. A $1,000,000 PWA program to be completed this year covers extensions of secondary feeder mains to strengthen and to eliminate dead ends, installation of elevated storage and boosters. The San Jacinto surface project has been shelved for the time being.

MINNEAPOLIS—The twelve Spaulding precipitators of the 120-m.g.d. water softening (lime treatment type) plant at Minneapolis were ready for the installation of agitator equipment and the walls of the superstructure. Two carbonation chambers are complete.

CHICAGO—The breakwater to protect the proposed South Side 400-m.g.d. water filtration plant is 20 per cent complete. Plans for the filters are under way. The 12-ft. diameter, 8,400-ft. tunnel under Des Plaines St. to the Cermak Pumping station is 65 per cent complete. A 10-ft. diameter, 22,500-ft. tunnel to the Roseland Pumping Station and a 16-ft. diameter tunnel, 5 miles long, under 47th St. from Western Ave. east ultimately to a new crib in the lake are 5 and 1 per cent completed respectively.

MILWAUKEE—The new $5,000,000 filter plant was completed late in 1938 and is now in the tuning up stage. The plant has a rated capacity of 200 m.g.d., and will treat the water taken from Lake Michigan.

Hydraulic fill operations are brought to completion on Quabbin Dam, major project of the new water supply for Boston.

BOSTON—Hydraulic fill on the 4,000,000 yd. Quabbin Dam on Swift River was completed at the end of the 1938 dredging season. Topping out the dam with 200,000 cu.yd. of rolled fill, placing of riprap and slope dressing and completion of the spillway, all to be done in 1939, will complete the last major link in Boston's new water supply. Contracts have been let for clearing 25,300 acres in the reservoir site, relocation of roads in the reservoir and the completion of two small flowage dams. Contracts have also been awarded for part of the new 18-mile Southboro aqueduct from Wachusett Reservoir, including a 3-mi. rock tunnel and 15½ miles of steel cylinder concrete pipe from 7 to 12½ ft. in diameter.

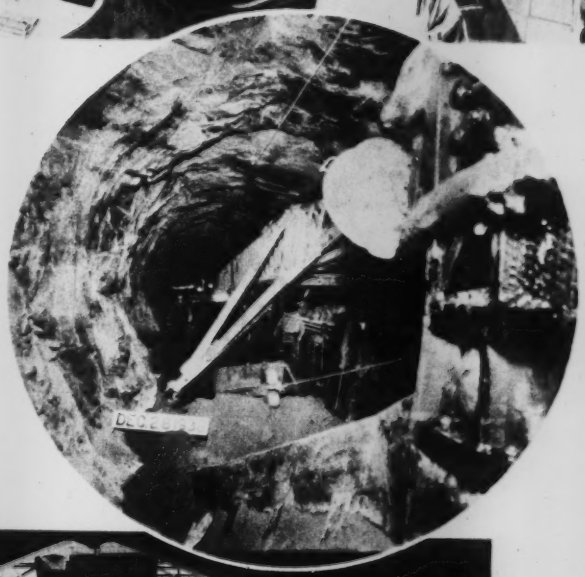
TOLEDO—Work has just started on a $9,000,000 water supply improvement program wherein Lake Erie water will be substituted for the supply now obtained from the Maumee River. Principal features of the project are: an intake into the lake, a pumping station discharging into a 13 mile pipe line to the filters, a new filtration plant and a high-lift pumping station.

DELAWARE PROJECT—Construction of the first stage of the Delaware River water supply project for New York City, which includes 30 shafts, 85 miles of rock tunnel and the Lackawack Dam, was well under way in 1938. Twenty-nine shafts, aggregating 17,665 ft. deep, were completed; intake Shaft No. 1, 950 ft. deep, will be included in a tunnel section still to be let. Eight tunnel contracts were let last year, totaling 53.5 miles, for $99,433,236. The remainder of the tunnel, including the Hudson River crossing, will be awarded this spring. The cofferdams for the Lackawack earth fill dam and the diversion tunnel at the dam are well along. Contract for the completion of the 9,000,000-yd. dam which will create Roundout Reservoir will also be let this spring.

BALTIMORE—Excavation of the Montebello-Gunpowder Falls water tunnel for the city of Baltimore was completed in November when the last section was holed through. The new 12-ft. tunnel, 34,600 ft. long, will provide another conduit from the Gunpowder Falls supply to the filter plant. Driving operations proceeded in six headings from three shafts and one portal. Maximum monthly progress was 683 ft. in one heading, 3,680 ft. for all headings. The contractor is now placing invert concrete. Completion of the project is scheduled for the end of 1939.

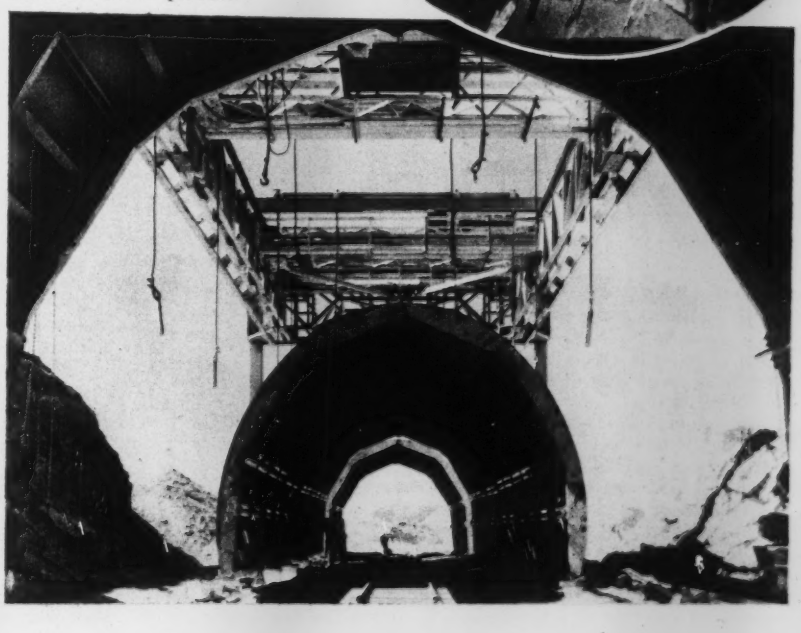
PHILADELPHIA—The Philadelphia Authority was created in September to finance and build improvements and extensions to the water supply system of the city, estimated to cost $20,000,000. The work consists of new construction and the development of wells and supplemental sources of water supply; extensions to the distribution system and replacements to the high pressure fire service; and rehabilitation of the five city filtration plants and pumping stations.

Double cone precipitators for the Minneapolis lime treatment water softening plant.



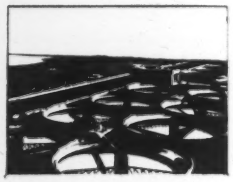
Cleaning up the Baltimore water tunnel with a special boom and dragline rig attached to a mucking machine.

Moving conduit forms on the Colorado River Aqueduct.



Aerial Surveys Inc., Cleveland, O.

Southerly sewage works at Cleveland where elaborate sludge digestion, filtration and incineration facilities handle the output from two treatment plants 13 miles apart



SEWAGE DISPOSAL

BUFFALO – The $13,500,000 intercepting sewer and treatment works project was completed and placed in operation in July. Meantime, a $9,000,000 program of storm water relief sewers was started. The 150 m.g.d. disposal plant (570 m.g.d. capacity for stormwater treatment) provides sedimentation and chlorination; sludge is digested, dewatered and incinerated.

COLUMBUS – This 50 m.g.d. activated-sludge plant was advanced far enough to start primary treatment a year ago but full operation did not begin until this July. Excess activated-sludge is dewatered in centrifuges prior to digestion; digested sludge is dewatered and incinerated. Now being added are three 750 hp. sludge gas engines driving three 500 kva. electric generators.

NIAGARA FALLS – In November a 50-m.g.d. partial treatment plant was placed in operation. This plant employs fine screens covered with a thin mat of coke which serves as a coarse filter for the removal of solids. The mixture of screenings and coke is burned in one of the two 80-ton capacity sludge incinerators. Plant effluent is chlorinated before discharge into the Niagara River. About 5¼ miles of intercepting sewers in tunnel were built to divert the sewage to the plant which hangs on the side of a deep gorge.

ONONDAGA COUNTY, N. Y. – In the 4.5 m.g.d. activated sludge treatment plant to serve Syracuse and adjacent suburban territory, equipment is being installed with the expectation of starting operation in March. Primary treatment includes screening, grit removal and sedimentation, to handle a maximum flow of 10 m.g.d. A magnetite filter and cascade aerator provide further treatment for the final effluent. Facilities are included for sludge digestion, single or multiple stage; utilization of gas for power; and sludge drying on sand beds. About 5½ miles of trunk and 3½ miles of lateral sewers are included in the project. The total cost is $3,000,000.

CHICAGO – The $60,692,000 PWA program of the Sanitary District of Chicago started in 1933 is rapidly nearing completion. To date 78 contracts have been completed and 11 are in progress with disbursements reaching $56,000,000. Early this year the 400-m.g.d. Southwest treatment works will go into operation. The Chicago River controlling works went into service Jan. 1 concurrent with the reduction of lake diversion to 1,500 sec.ft. as required by the decree of the U. S. Supreme Court. The 1,500-sec.ft. Racine Ave. pumping station for stormwater will be ready for service July 1. When this program (total cost $162,697,000) is completed the District will be collecting and treating 99 per cent of the sewage and industrial wastes of its area, equivalent to 6,468,000 population.

ATLANTA—With the Intrenchment Creek plant (14 m.g.d. complete treatment) and the Clayton works (40 m.g.d. primary treatment) placed in operation this year, Atlanta has almost reached the completion of a $7,000,000 sanitation improvement program embracing the construction of 86 miles of sewers and six disposal plants. The sewers are 75 per cent completed, four disposal plants are in operation, and two small plants are in the design stage.

DETROIT – Intercepting sewer and treatment plant facilities, under construction for the last three years and estimated to cost $22,600,000, are approaching completion. The sewer system, sedimentation tanks and effluent conduits designed to accommodate a flow of 420-m.g.d. are finished. The pumping station, grit chambers, and sludge filter and incinerator building will be completed next June. Plant effluent will be discharged through an 18-ft. diameter, 6,000 ft. tunnel built in soft clay, with a submerged outlet 35 ft. below the surface of the Detroit River.

BALTIMORE – Major additions to Baltimore's Back River disposal plant this year include the installation of a three-unit detritor, one 170 ft. diameter primary sedimentation basin, one digestion tank, and sludge elutriation and vacuum filtration facilities. Construction was started on a 20 m.g.d. activated sludge plant.

Cascade aerator mounted on a magnetite filter for final treatment of plant effluent, one of the innovations at the Onondaga County, N. Y. disposal plant near Syracuse.

DENVER—The Williams Fork transmountain diversion tunnel to augment the flow of water past the $1,500,000 Denver sewage treatment works, put in service in 1937, is 60 per cent complete. Collecting works, including ditches, dams, catch-basins and 19,000 ft. of steel pipe, to assemble 275 sec.-ft. of runoff on the western slope at West Portal elevation of 10,400 ft. were completed last September.

SPRINGFIELD, MASS. — Work was recently started on a $2,600,000 sewage disposal program involving the construction of intercepting sewers and two treatment plants. Bids will be taken in February for the main treatment works, a 30 m.g.d. sedimentation plant employing sludge digestion, filtration and incineration. A small plant (under 3 m.g.d.) will be built eventually to treat the sewage in a section of the city lying in a separate drainage area.

CLEVELAND — Placed into operation this past summer was the 123 m.g.d. Easterly activated sludge plant and the remodeled 45 m.g.d. Southerly plant where abbreviated aeration units are used between existing Imhoff tanks and trickling filters followed by magnetite filters. At the latter plant are located the sludge disposal facilities — digestion tanks, gasholders, vacuum filters and four 100-ton incinerators—for both the Southerly and Easterly treatment works. Sewer service charges will provide funds for operating the disposal works.

NEW HAVEN, CONN. — Cofferdam construction and pile-driving for the Boulevard sewage treatment works is underway. This is a 14 m.g.d. sedimentation plant where sludge will be digested, filtered and incinerated. The entire improvement program is costing $1,500,000.

CINCINNATI — A report on sewage treatment facilities for the Little Miami River area has been submitted and bond issues in the amount of $1,000,000 approved. The treatment recommended is sedimentation coupled with sludge digestion, filtration and incineration. Also under way is the development of a comprehensive plan of sewerage serving the remainder of metro politan Cincinnati.

MEMPHIS — The two contracts for 14,400 ft. of 7x7.8-ft. intercepting sewer tunnel under Front St., Memphis, were about 43 per cent complete at the end of the year. Driving of the tunnel, which lies from 50 to 90 ft. below street surface in wet clay, sand and gravel, requires from 8 to 28 lb. of compressed air. The project, including three special structures and pump plants, will divert much of the city's sanitary sewage to the Mississippi River below the town. Completion of the contracts, aggregating $1,768,245, is scheduled for May.

TWIN CITIES — The Minneapolis-St. Paul 134 m.g.d. sewage disposal plant and 52 miles of interceptors were completed, and treatment operations began on June 1, 1938. The project cost $16,000,000, which was $2,000,000 under the original estimate. Chemical treatment facilities provided for use during low water conditions have not been needed thus far. Plain sedimentation and filtration through magnetite filters are providing a 73 per cent removal of suspended solids.

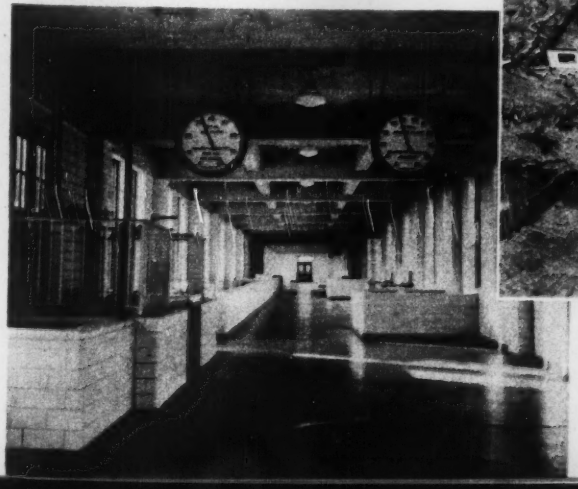
PHILADELPHIA — The Philadelphia Authority will finance and build sewage treatment and disposal facilities for the city, which is under state order to abate pollution in the Delaware and Schuylkill Rivers. The present program contemplates the extension of facilities of the existing plant in the northeast district of the city, and construction of new plants in the southwest and southeast districts. The total estimated cost is $40,000,000. The capacity of the three plants is to be 386 m.g.d., including the increased capacity of the Northeast treatment works from 50 to 120 m.g.d.

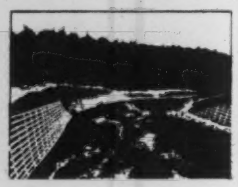
NEW YORK CITY — Pushing forward on the largest single sewage disposal program ever undertaken anywhere, New York City now has three treatment plants under construction and designs are being prepared on three others. The program contemplates installation of 32 plants, only two of which (Wards Island and Coney Island) are already in operation. Of the plants under construction, the Tallmans Island job (40 m.g.d. activated-sludge) will be completed in January; the Jamaica treatment works (65 m.g.d. activated-sludge) is 10 per cent completed. The Bowery Bay plant (40 m.g.d. activated-sludge) which has just been started will be ready for partial operation in 1939, but will not be completely finished until July 1940. Also under construction are intercepting sewers totaling over $1,000,000. Under design are: a 35 m.g.d. extension to the Coney Island sedimentation and chemical precipitation plant; the 26th Ward 50 m.g.d. activated-sludge plant; and the City Island 1.5 m.g.d. primary plant.

McLaughlin Aerial Surveys

New York's newest disposal plant nears completion. The Tallman's Island 40 m.g.d. activated sludge works.

Aeration control gallery at the Columbus 50 m.g.d. activated sludge treatment plant.





FLOOD CONTROL

ATCHAFALAYA BASIN—Flood control operations in the lower Mississippi River region last year were largely confined to the Atchafalaya River. Here the east and west control levees, involving millions of yards of earthwork, were practically completed. The Wax Lake outlet at the lower end of the river was started. Widening and deepening of the main river channel was continued.

UPPER SUSQUEHANNA—Two rolled fill earth dams were started by the Binghamton, N. Y. Engineer District on the headwaters of the Susquehanna River. Arkport Dam, on the Canisteo River near Hornell, was awarded in May for $1,026,000. It will contain 900,000 cu.yd. of fill (42 per cent is placed), and 14,000 cu.yd. of concrete. Whitney Point Dam, on the Otseltic River, includes 2,600,000 cu.yd. of fill, 43,000 cu.yd. of concrete and a 13-ft. outlet conduit 1,400 ft. long. The contract was let in September for $2,700,000

OHIO VALLEY—Several local protection projects were started in the Ohio Valley last year, and numerous others were in the investigation and planning stage. At Johnstown, Pa., channel improvements are under way in the Conemaugh River. A concrete wall and earth levee project has been completed at Wellsville, O. At Huntington, W. Va., a concrete wall was built along the Guyandot River, a wall is under construction along the Ohio River front, and plans are being made for walls and levees along the main river and two creeks. Contracts will soon be let for flood walls in the towns of Ceredo and Kenova. Extensive levees and walls are being built at Ironton, Ohio.

UPPER OHIO VALLEY—Except for reservoir clearing and minor work in connection with levees and utility relocations, the fourteen dams in the Muskingum flood control project in southeastern Ohio are complete. Tygart Dam, on the Tygart River in West Virginia, was also completed early in the year. In the Allegheny River valley two reservoir dams, Tionesta and Crooked Creek, were started and a third, Mahoning, placed under contract just as the year closed. At Crooked Creek, which is to be a 1,400,000-yd. earth and rock fill, cutoff trenches and the diversion tunnel were finished. At the 2,000,000-yd. Tionesta earth fill dam the diversion tunnel has been excavated but not lined; spillway excavation and placing of fill have been started. The Mahoning project includes a concrete dam 160 ft. high and 993 ft long, containing 232,000 cu.yd. of concrete.

NEW ENGLAND—Floods and a hurricane which struck New England in September brought to a head the long-delayed flood control plans for this region. One project, the Pittsburg Dam on the headwaters of the Connecticut had already been placed under contract by the New Hampshire Water Resources Board. The U.S. Engineer Department is rushing plans for six dams to be built on the Connecticut and Merrimack watersheds. Contract will soon be let for the 2,500,000-yd. rolled fill dam at Franklin Falls, N. H., on the Pemigewasset River. During the year contracts will be let for the following dams, all rolled or hydraulic earth fills: Riverhill, Contoocook River, N. H.; Union Village, Ompompanoosuc River, Vt.; Surrey Mountain, Ashuelot River, N. H.; Knightville, Westfield River, Mass.; and Birch Hill, Millers River, Mass.

CALIFORNIA DEBRIS DAMS—Construction started in July on the first of four dams to be built under supervision of U. S. Engineer Department on California streams for storing hydraulic mining debris. Estimated total cost is $7,000,000. The first one, on the north fork of the American River, is an arch dam 155 ft high to store 27,700,000 cu.yd. The second on the Yuba River, will be an arched gravity section 237 ft. high, to store 136,500 cu.yd. Later, a dam on the middle fork of the American River is to be built 148 ft high to develop a 24,900,000-cu.yd. storage. A triple-arch structure 122 ft. high also will be built at Dog Bar on the Bear River to develop a 32,150,000-cu.yd. storage.

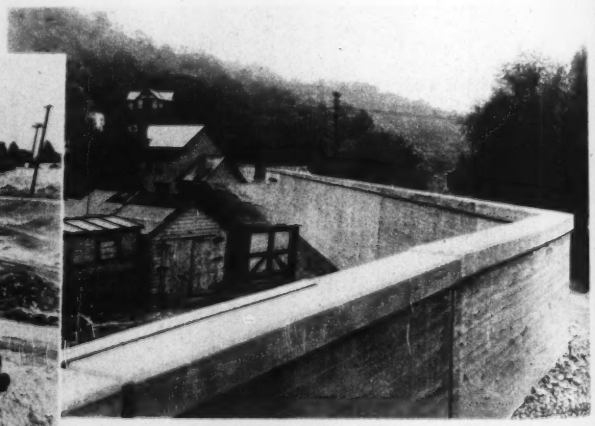
SAN GABRIEL DAM NO. 1—Completion by the Los Angeles County Flood Control District of San Gabriel Dam No. 1 is scheduled for this March. The last pour in the spillway was made two weeks before the flood of March 2, 1938 which caused a spillway discharge of 56,000 sec.-ft. This flood left 10,000,000 cu.yd. of debris in the reservoir and as a consequence the trash rack tower is being raised about 40 ft.

PRADO DAM—The Orange County (Calif.) flood control project, estimated to cost $15,248,000 and involving a series of eight earth-fill dams, was begun in 1936 with preliminary work on Prado Dam, a 3,130,000 cu.yd. rolled earth-fill on the Santa Ana River near Corona. This dam will be 2,350 ft. long and will have a maximum height of 100 ft.

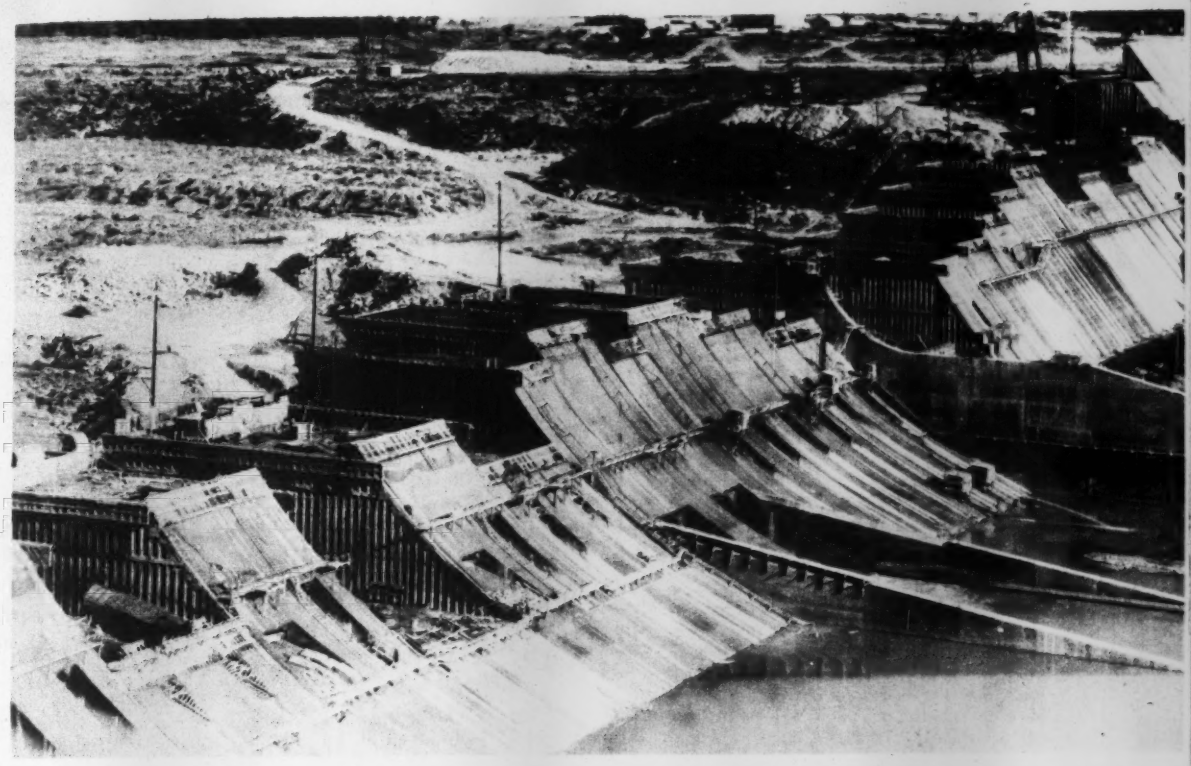
LOS ANGELES COUNTY—Urged forward by the disastrous floods of March, 1938, a $70,000,000 flood control program for Los Angeles County is being carried out by the U. S. Engineer Department. Expenditures already made total $25,000,000; of this $17,768,000 was spent on channel protection along 13 mi. of the Los Angeles River. Concrete or rubble channels were built on numerous smaller streams, and surveys were started on the San Gabriel River and tributaries, including the proposed Whittier Narrows and Santa Fe reservoirs.

Work started in August on Hansen Dam, a $6,000,000 rolled-earth fill on the Big Tujunga Creek. Some 13,000,000 cu.yd. of

Channel improvement on the Los Angeles River where a concrete toe and slope is under construction.



Barrier against the Ohio's high waters. This concrete wall at Wellsville is typical of many being built along the riverfront for flood protection.



Spillway section of Marshall Ford Dam, major flood control project on the Colorado River in Texas.

material will be put in this dam which will have a length of about 9,000 ft. and will rise about 100 ft. above streambed.

MARSHALL FORD DAM—The $12,000,000,190-ft. Marshall Ford Dam, major flood control feature of the Colorado River Project in Texas, is approaching the final stages. Of an estimated 1,089,000 cu.yd. of concrete about 75 per cent has been placed. In May the river was diverted through two 26-ft. dia. conduits, permitting placement of concrete in a continuous succession of blocks across the main river. In August $1,250,000 additional was allotted for adding a block 40 ft. high and 58 ft. thick upstream to the river section of the high dam, ultimately to rise to 268 ft.

CONCHAS DAM—This $16,500,000 flood control and irrigation project on the South Canadian River in New Mexico, involving a 235-ft. high concrete gravity dam across the river flanked by long earth dikes at either end, is 80 per cent complete; it is to be finished this year. Over 600,000 of the 750,000 cu.yd. of concrete has been placed, the 30-ft. high north dike was completed in August, 1937, and the 98-ft. south dikes, 6,400 ft. long and involving 2,500,000 cu.yd. of rolled earth fill, was completed in December. The emergency spillway requiring 66,000 cu.yd. of concrete, and the irrigation headworks consisting of a tunnel requiring 167,000 cu.yd. of excavation and 6,100 cu.yd. of concrete, is under way.

CABALLO DAM—The $2,150,000 Caballo Dam storing 350,000,000 acre-ft., was completed in September. It is a combination flood control unit in the Rio Grande rectification project of the International Boundary Commission and an irrigation regulating reservoir for the U. S. Bureau of Reclamation permitting continuous hydro-electric power development at Elephant Butte Dam, 25 miles upstream.

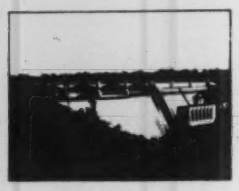
GRAND RIVER PROJECT — Pensacola Dam, the main feature of an extensive hydro-electric and flood control project, is under construction on the Grand River in northeastern Oklahoma. Providing flood protection for the Arkansas River valley, it will also furnish power generated by four 20,000 hp. turbines to be installed at present, with provision for two future additional units of the same size. The project is being built by the Grand River Authority, created by the Oklahoma legislature. The main dam consists of 51 buttressed concrete arches of 84 ft. span, 861 ft. of gravity overflow section and 451 ft. of non-overflow gravity section, a total length of 5,596 ft. Preliminary construction operations, now complete, included a railroad and highway to the site. Excavation has also been completed for two saddle spillways. The dam is ready for concrete.

POSSUM KINGDOM DAM—Construction of Possum Kingdom Dam on the Brazos River near Mineral Wells, Texas, has been under way since April. It is the first of 13 flood control dams to cost $50,000,000 proposed by the Brazos River Conservation and Reclamation District. The dam is of the Ambursen massive-buttress type, 125 ft. high with buttresses on 40-ft. centers. Completion is scheduled for early in 1940. Included in the project is a power plant of 37,500 kw. capacity.

RIO GRANDE RECTIFICATION—River rectification in the El Paso-Juarez Valley is about completed. This project of the International Boundary Commission, United States and Mexico, is designed to furnish flood protection benefits and stabilization of the river boundary between two countries. On Jan. 1 a total of 167 miles of levee and 85 miles of river channel had been built, involving 17,700,000 cu.yd. of earthwork. About 5,000 acres of land from the United States was traded for an equal area coming from Mexico in the river straightening. The Rio Grande from El Paso to Fort Quitman was shortened from 155 to 88 miles.

LOWER RIO GRANDE — The United States and Mexico continued during 1938 the building of international flood-control works in the Rio Grande delta area. The United States portion will include 120 miles of levee along the river, 180 miles of floodway channels, 200 miles of floodway levees and numerous incidental structures. During the current fiscal year $2,000,000 was available. The United States section is now engaged in constructing levees in Cameron and Hidalgo counties, and channel improvements along the North Floodway in Hidalgo County. Good progress was accomplished by Mexico on construction of river and floodway levees.

RIO GRANDE CANALIZATION—Canalization of the Rio Grande consists of two features, the American dam and canal near El Paso, and the channel canalization of the river for 100 miles from Caballo Dam in New Mexico to the American Dam. The United States Section of the International Boundary Commission is doing the work. The American Dam consists of a concrete diversion dam of the radial gate type across the Rio Grande serving a 2-mi. concrete-lined canal. It was placed in operation on June 2. Construction is now under way on the canalization feature.



POWER & IRRIGATION

BONNEVILLE DAM – In addition to the two 66,000-hp. units installed in the Bonneville power house in 1937, two more units of 74,000-hp. capacity were on order in 1938 for immediate installation. To make this power available, work is under way on a network of transmission lines, totalling 600 mi. in length.

BOULDER POWER PLANT – On Nov. 22 the N-6 (Nevada) generating unit went into operation, making an installed capacity for the plant of 745,000 hp., out of an ultimate 1,835,000 hp. Six 115,000 hp. turbines are now operated by the Los Angeles Department of Water and Power and one 55,000 hp. turbine is being operated by the Nevada-California Power Co. Two additional large generating units are being installed.

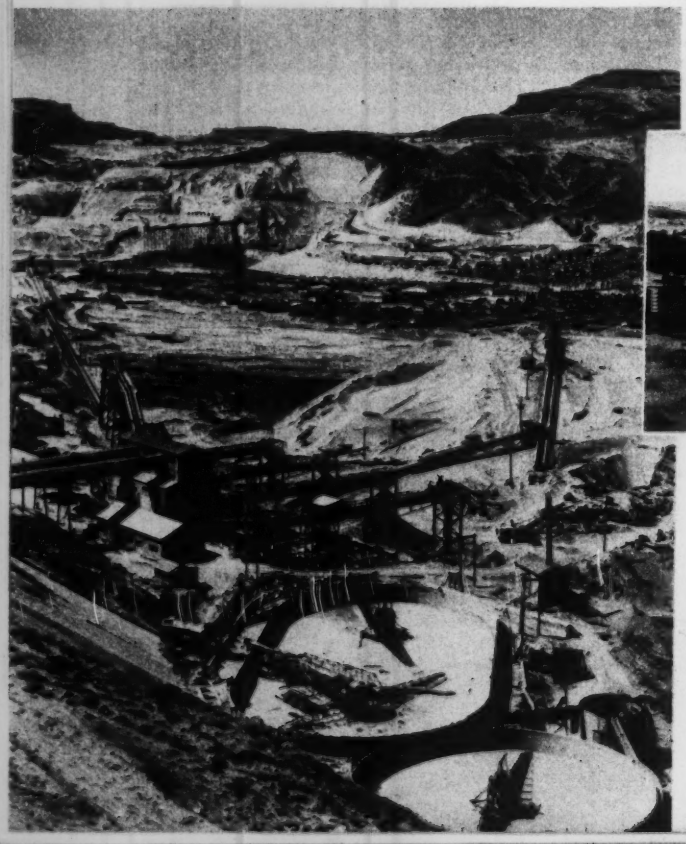
COLUMBIA BASIN – Initial development at the Grand Coulee Dam, comprising construction of the concrete base to a height of 250 ft., the placing of 4,541,909 cu.yd. of concrete and 17,177,042 cu.yds. of excavation, was completed in March at a cost of $39,500,000. In February a $34,442,000 contract was awarded for completion of the 550-ft. dam, the left power house, and the foundation for the pumping plant, four years being allowed on the contract. This work is about 15 per cent completed and 900,000 of the total of 5,809,500 cu.yds. was placed. The dam and power plant were about 40 per cent completed. In January a contract was awarded for furnishing three 72-in. dia. and eighteen 18-ft. dia. pump-inlet pipes. In the fall orders were placed for three 108,000 kva. generators and turbines. These units, the largest ever built, are the initial units of the 2,742,000 hp. power plant.

SKAGIT PROJECTS – During 1938 the foundation was unwatered at Ruby Dam on the Skagit River where Seattle plans water storage for the power plants below. The first stage of Ruby Dam will be an arched structure 210 ft. high. Later its height is to be increased to 445 ft. and, ultimately to 658 ft.

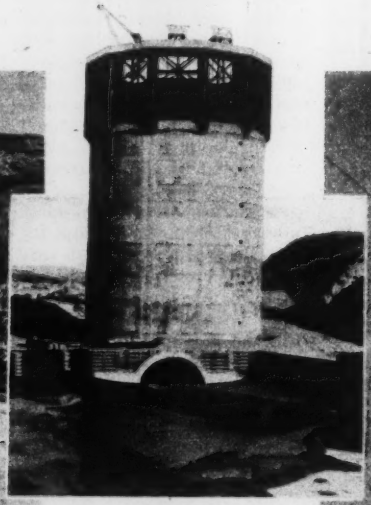
TRI-COUNTY PROJECT – In the Central Nebraska Power and Irrigation District 60 contracts, amounting to about $20,000,000 out of an estimated $35,986,000 cost have been awarded. The largest item, Kingsley Dam, is well under way. Hydraulic fill dredges are under construction and pumping will start in 1939. The 33 miles of relocation of the Union Pacific R.R. is 50 per cent complete. The 75-mile supply canal is about 30 per cent complete. One power house is under construction, contracts for the other two were let Dec. 30, and one diversion dam is in operation. The irrigation system and the transmission lines are about 50 per cent completed.

CLAYTOR – The Claytor hydro-electric plant on the New River near Radford, Va., is about 90 per cent complete; it is being built by the Appalachian Electric Power Co. The dam is concrete gravity type 120 ft. high and 1,200 ft. long, creating a reservoir of 225,000 acre-ft. The power plant contains four 26,000 hp. turbines operating under a head of 110 ft.

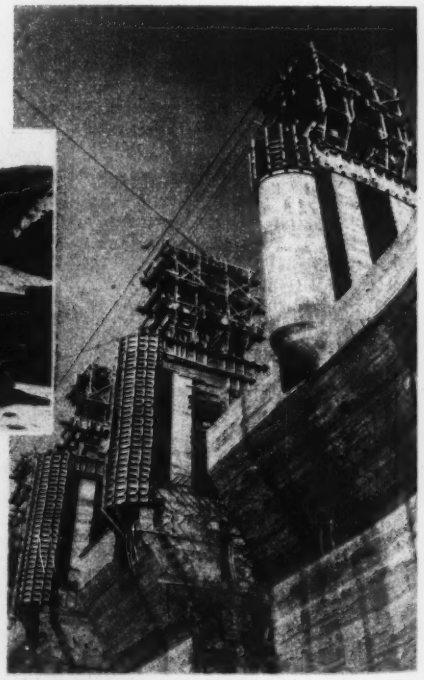
RIO GRANDE PROJECT – Caballo Dam on the Rio Grande, about 100 miles upstream from El Paso, and 25 miles below Elephant Butte Dam, was completed in September. It is an earth and rock-fill structure, 95 ft. high with a crest length of 4,447 ft.; it will store 350,000 acre-ft., of which 100,000 acre-ft. is for flood control in connection with the stabilization of the U.S.-Mexico boundary. Caballo Dam forms a regulating reservoir which will allow a power plant at Elephant Butte to operate continuously, while the recaptured water can be released for irrigation. In November river channel excavation was started on the Elephant Butte development; a power plant is to be constructed here by government forces. It will contain three 11,500 hp. turbines.



At Grand Coulee Dam water for washing aggregate is pumped from the river to this screening plant. Too valuable to waste, the water is clarified and re-used.

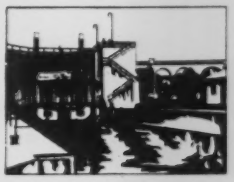


Morning-glory spillway for the Tri-County power project in Nebraska.



Spillway piers of the Claytor hydro-electric plant near Radford, Va.

WATERWAYS



CAPE COD CANAL—Since the U. S. Government assumed ownership and operation of this waterway in 1928 the original bottom width of 100 ft. has been increased to 315 ft. through the 7.7-mile land cut, a stone revetment 2 ft. thick has been placed on both banks of the cut between 5 ft. above mean high water and 5 ft. below mean low water, three high-level bridges have been built over the canal, the channel in Buzzards Bay as been widened to 500 ft. and deepened to 32 ft., dikes have been built in the bay to control currents, and mooring basins at each end of the canal have been completed. The controlling depth is now 24 ft., but three contracts are under way to provide a 32 ft. depth throughout and to widen the land cut to 480 ft. bottom width. Work will be completed in 1940. The ultimate project as authorized by Congress calls for 32 ft. depth and 540 ft. width.

FORT PECK DAM — This hydraulic fill dam, being built on the Missouri River in Montana by the Army Engineers, entered its sixth year of construction on Oct. 23, 1938. Plans for completion of the fill in November were interrupted when a section of the upstream embankment at the east abutment slumped on Sept. 22. Over 20,000,000 cu.yd. of fill was placed this season to raise the total placed since start of dredging late in 1934 to 97,000,000 cu.yd. Riprap on the upstream slope is now 40 per cent complete; in September the 2-mile spillway structure was completed. Foundations of the inner towers in two of the gate control shafts were completed. Dredging operations last year included placing 1,069,000 cu.yd. in a downstream toe berm and the completion of the 2-mile dike west of the dam.

TENNESSEE RIVER—The Tennessee Valley Authority now has under construction five dams. The Gilbertsville project, 22½ miles upstream from the mouth, is in the preliminary stages. Pickwick Landing Dam, below Wilson Dam, is complete and two generating units were placed in operation during the year. Guntersville Dam, the next above Wheeler, is in its final construction phase. Chickamauga Dam, immediately above Chattanooga, was started early in 1936. The north earth embankment is about 75 per cent complete. The lock is completed and in temporary operation. About 90 per cent of the spillway has been finished. The powerhouse section, where most of the work now is going on, is about one-third complete. At Hiwassee Dam, on the Hiwassee River, foundation excavation is practically complete. Foundation concreting in cofferdam No. 1 is finished, and concreting of the foundation in the second cofferdam is about two-thirds finished. Placement of concrete for the main body of the dam and spillway apron is about 30 per cent complete.

SANTEE-COOPER PROJECT—Contracts have been let for turbines and generators having a capacity of 213,000 hp. for the Santee-Cooper power and navigation project near Charleston, S. C. Bids have been called on the power-house, locks and dam on the Cooper River at Pinopolis and bids soon will be asked on the main diversion dam across the Santee River, an earth structure 4,000 ft. long and containing 8,000,000 cu.yd. of fill. An average head of 70 ft. is to be developed at Pinopolis. The Cooper River will be made navigable for 145 miles up to Columbia.

Widening and deepening operations are making Cape Cod Canal a first-class seaway.

Hiwassee Dam, a 300 ft. high water control structure of the TVA system, will aid navigation in the Tennessee River and help in the control of floods.

LAND RECLAMATION

ALL AMERICAN CANAL – Excavation was completed in 1938 on the entire 80-mi. length of this 15,155-sec.-ft. canal and all structures along the first 36 mi. were finished. On Oct. 18 Imperial Dam and desilting works was formally dedicated and the first water was turned into the canal. Excavation on the first 40 mi. of the 2,600-sec.-ft. Coachella Canal was begun in August and specifications for the next 40 mi. were in preparation. This and the following irrigation projects are being built by the U. S. Bureau of Reclamation.

KENDRICK – The Alcova diversion dam of the Kendrick irrigation project in Wyoming, an earth and rock-fill structure, 180 ft. high, was completed in May at a cost of $3,100,000. The last pour was made in Seminoe Dam, a 260-ft. concrete masonry structure, on Nov. 26. Contracts were awarded for a third generating unit, making the total capacity of the power plant 45,000 hp. Work was continued on the 62-mile Casper Canal, laterals and structures, for the first unit of 35,000 acres, which are scheduled for completion in 1940.

GILA PROJECT – Excavation of the 20-mi. main canal on the Gila project including the driving and lining of two 20-ft. tunnels, was completed in 1938 and work was begun on a 19½ ft. siphon, 2,100 ft. long, across the Gila River. Contract was awarded for the construction of several wasteways, checks and a siphon across Fortuna wash.

CENTRAL VALLEY PROJECT – The heavy construction stage has been reached, and contracts have been awarded totaling more than $40,000,000. Status of the several parts of the work were:

Kennett Division: Excavation at Shasta Dam site is proceeding on both abutments and in the diversion channel; the railroad bypass-tunnel through the west abutment was well under way. Bids have been called on four generators, each to have a capacity of 75,000 kva.

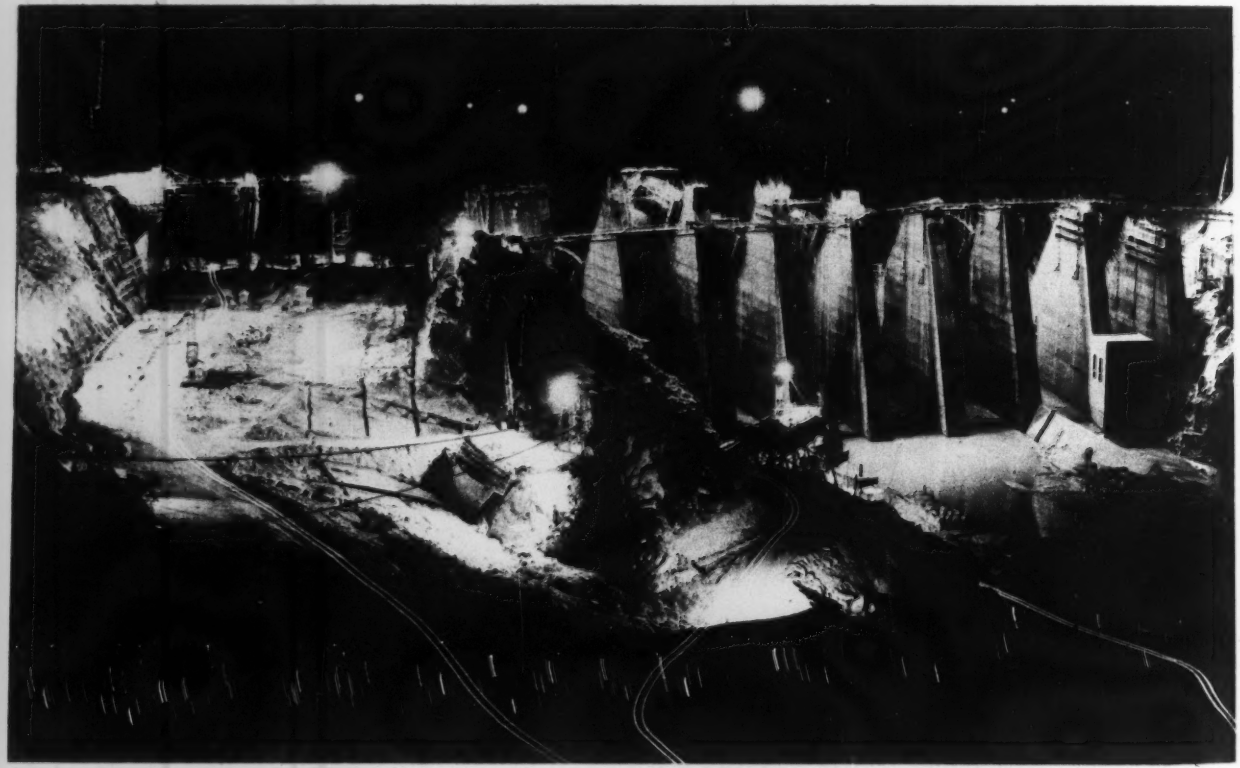
Railroad Relocation: Work has begun or bids have been called for relocation of 37 mi. of main line of the Southern Pacific Ry. on a new route around Shasta reservoir, including three of the eight major bridges, four of the twelve tunnels and fifteen mi. of grading. On the very large bridge across Pit River, plans and specifications were under way. Piers for the new bridge across the Sacramento River at Redding were being built and steel erection was scheduled to start March 1.

Delta Division: Four miles of the Contra Costa canal were completed; construction was under way on the next 8 mi.; contracts were awarded for four pumping plants and bids were in on another 8-mi. canal section. Field location was completed for the entire 46 mi. of canal.

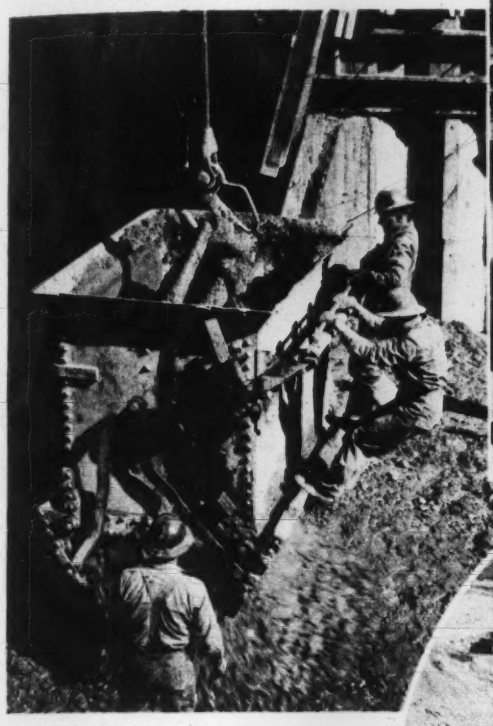
Friant Dam: Field location on the Friant-Kern canal was advanced to a total of 70 mi.; location of the Madera canal was completed to Fresno River.

SHOSHONE-HEART MTN. – The distribution system for the 42,000 acres in the Heart Mountain division of the $6,500,000 Shoshone project in Wyoming is 40 per cent complete. Contracts covering 12 mi. of

The night shift carries on at Bartlett Dam in Arizona, highest multiple arch structure in the world. This downstream view shows the 270 ft. high buttresses which support the arches. The reservoir created by the dam will store 200,000 acre-ft. of water.



Twin tubes, 15½ ft. in diameter, will carry the All-American Canal over the New River in California.



Pouring the last lift in Seminoe Dam in Wyoming, the concrete work on which was finished in November.

Lining a curved section of the 99-mile Yakima Canal which will carry water for the irrigation of 72,000 acres.

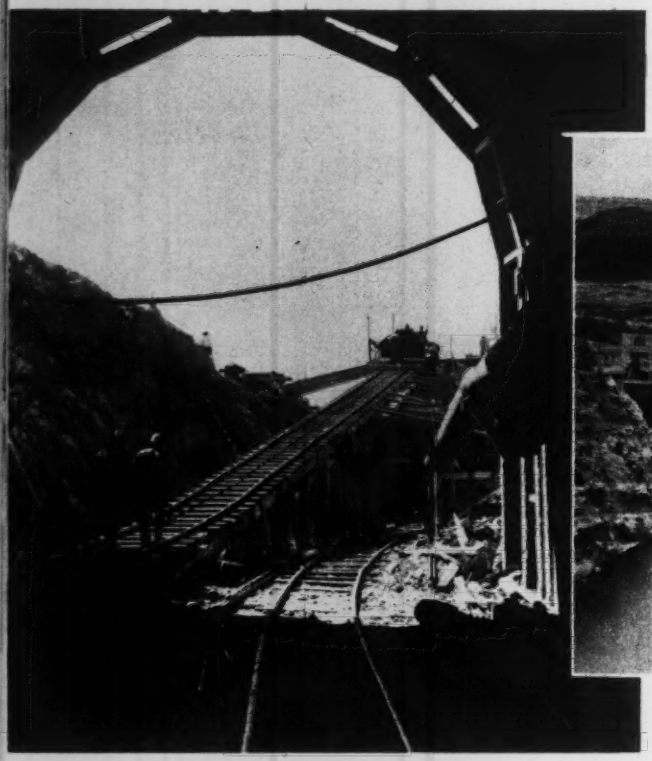
the 28-mi. Heart Mountain Canal were completed during the year. Bids were invited for construction of the Shoshone River siphon and the Buck Springs Creek siphon. The Shoshone Canyon conduit is a common feature of both the Heart Mountain division and the proposed Oregon Basin division. It will be about 3 mi. in length, mostly in tunnels, and have a capacity of 1,200 sec.-ft. Three of the conduit tunnels, totaling 2 mi. in length, were completed in November.

RIVERTON – On this project in Wyoming, the Bull Lake Dam was completed in July at a cost of $1,020,000. It will provide 155,000 acre-ft. of storage for the project lands. The structure is an earth-fill embankment 75 ft. high. Work was in progress on the Pilot Butte canal and lateral system.

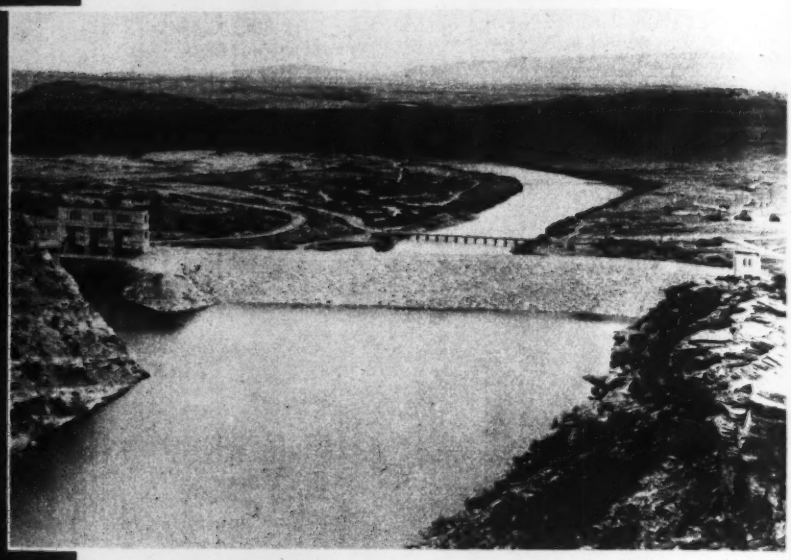
SALT RIVER – The 286-ft. Bartlett Dam on the Verde River in Arizona was brought to 93 per cent completion. This concrete multiple-arch structure is the highest of its type in the world and will create a reservoir of 200,000 acre-ft. capacity.

BOISE-PAYETTE – Work was in progress on the canal and lateral system for the irrigation of 47,000 acres in the $6,678,000 Payette division of the Boise project in Idaho. Two contracts covering earthwork, canal lining, and structures on 15 of the 27 miles in the Black Canyon Canal were completed and contracts were awarded for an additional 6 miles, which will complete this main canal.

COLORADO-BIG THOMPSON – This $44,000,000 project got under way in November when a contract was awarded for the construction of the Green Mountain Dam on Blue River in Colorado. The dam will be an earth and rock-fill embankment with a maximum height of 270 ft. above stream bed, a crest length of 1,300 ft. and a volume of 4,400,000 cu.yd. It is the second highest and largest structure of its type in the United States, being exceeded only by the San Gabriel No. 1 Dam in California. Details of the complete project were given in ENR Jan. 5, p. 17.



Shoo-fly tunnel at Shasta Dam in northern California which will serve the dual purpose of a temporary by-pass for the Southern Pacific Ry. and later as a river diversion conduit.



Alcova Dam in Wyoming, the diversion structure of the Kendrick project which will store 160,000 acre-ft. of water.

PROVO RIVER – In March a $2,189,000 contract was awarded for the Deer Creek Dam on the Provo River, near Provo, Utah, which was the first work on this $15,500,000 project. The dam is a rolled earth fill 155 ft. high, 1,300 ft. in length, and will create a reservoir of 150,000 acre-ft. It will be necessary to relocate about 10½ miles of the Denver and Rio Grande Western R.R. Contract for the Alpine-Draper and Olmsted tunnels on the Aqueduct Division was let in December at $746,535. Both tunnels will be 6½ ft. in diameter concrete-lined, with a combined length of 18,600 ft. The aqueduct will be 40 mi. in length, with a capacity of 150 sec.-ft. and will convey water from the Deer Creek reservoir to a point near Salt Lake City.

UTAH PROJECTS – Other than the Provo River project, the Bureau of Reclamation had work in progress on the Moon Lake and Sanpete projects. The Moon Lake Dam, a 110-ft. earth-fill structure, was completed in May at a cost of $1,210,000; all work on the Midview Dam, dike, and reservoir was completed in December; the Yellowstone feeder canal, 34 miles long, and the Duchesne feeder canal, 22 mi. long, were well along towards completion. On the Sanpete projects work was continued on the Ephraim and Spring City tunnels which will divert water from the Colorado River Basin through the Continental Divide to Ephraim Creek and Oak Creek in the Great Basin, and provide a supplemental supply for 12,755 acres of project lands.

BUFFALO RAPIDS – The Glendive unit of the Buffalo Rapids project in Montana was under construction during the year. The irrigable lands comprise 17,000 acres along the Yellowstone River in the vicinity of Fallon and Glendive. Work continued on the 32-mile main canal, which is a work relief project financed with an allocation of $1,605,000 from WPA.

OWYHEE – This $18,000,000 project of 117,000 acres in Oregon and Idaho was practically completed at the end of the year. During 1938 work was in progress on the lateral system under the South Canal on the Succor Creek division and on the Owyhee Ditch and Succor Creek No. 2 pumping plants.

YAKIMA-ROZA – Work on the 72,000-acre Roza Division of the Yakima project in Washington included completion of 13.7 miles of the 99-mi. Yakima Ridge Canal, also 3.4 miles of tunnels, and the Pomona siphon under the Yakima River. In August a $526,860 contract was awarded for the construction of the Roza Diversion dam on the Yakima River. The estimated cost of the irrigation works for the division is $15,000,000.

UPPER SNAKE RIVER – The Island Park Dam near Island Park, Idaho, was completed in November. It is a rolled fill 85 ft. high and 1,600 ft. long flanked by an earth-fill dike, 10 ft. high and 7,900 ft. long. The reservoir will have a capacity of 129,000 acre-ft. Work on the 120-ft. Grassy Lake Dam, on Grassy Creek in northwestern Wyoming, now shut down for the winter, is 61 per cent completed. The Cross Cut diversion dam, Cross Cut Canal headworks, and the 6.6-mile canal to the Teton River, were completed in January of last year.

TUCUMCARI – Preliminary operations were started on the $8,300,000 Tucumcari irrigation project in New Mexico in November, which will provide water for 45,000 acres in the Arch Hurley district. Irrigation works will comprise a diversion tunnel, a main canal 55 miles in length, laterals, structures and drains. Storage for the project will be in the Conchas reservoir of 226,000 acre-ft. capacity on the Canadian River now being built by the army engineers.

DESCHUTES – This project in Central Oregon was started in June. A storage reservoir on the Upper Deschutes River at the Wickiup site is planned along with a 65-mile main canal to serve about 50,000 acres near Madras, Ore.

TRUCKEE RIVER – Boca Dam on the Little Truckee River, near Boca, Calif., is about 80 per cent completed. This is a 110-ft. earth and rock-fill structure to provide a storage capacity of 41,250 acre-ft. to supplement the water supply of 27,500 acres near Reno, Nevada.

MILK RIVER – Fresno Dam on the Milk River project in Montana is 62 per cent complete. The dam is an earth fill 77 ft. high and 1,900 ft. long. The reservoir storage of 127,228 acre-ft. will provide a supplemental supply for project lands.

PINE RIVER – On the Pine River project in southwestern Colorado a contract was awarded in March for the construction of the Vallecito Dam, located about 23 miles north of Bayfield. It will be an earth-fill structure 150 ft. high and 3,965 ft. long. About 25 per cent of the work was completed during the year. The project has an irrigable area of about 69,000 acres in Colorado and New Mexico.

BRIDGES

ATCHISON, KANS. – Opened to traffic in September, 1938, this three-span (415-475-415 ft.) continuous truss crossing of the Missouri River was a joint project of the Kansas and Missouri highway departments. Approaches of deck trusses and I-beam spans bring the total length to 2,700 ft.

TOPEKA, KANS. – Containing a 217-ft. plate girder span, this 4,400 ft. structure costing $1,500,000 was opened to traffic in September. The five river spans are continuous built-up deck plate girders, 152, 186, 217, 186, and 152 ft. in length. The approaches consist principally of 3-span units of continuous reinforced concrete deck girders with span lengths of slightly over 50 ft. The road is 44 ft. wide.

WHITESTONE BRIDGE – At the end of the year cables were completed and floor steel erection had begun on this 2,300-ft. span suspension bridge being built by the Triborough Bridge Authority in New York City. The viaducts, grade separation bridges and paving on the 5 mi. of parkway that constitute the Bronx and Queens approaches are substantially completed, including the double-leaf bascule over the Flushing River in Queens.

MEEKER AVENUE, N.Y.C.–Connecting the New York City boroughs of Brooklyn and Queens, this crossing of Newtown Creek is second only to the Whitestone Bridge in importance in the metropolitan area. It will provide an approach to the World's Fair from the south as the Whitestone Bridge will provide one from the north. Some 6,400 ft. in total length, the Meeker Ave. bridge, a project of the municipal department of public works, will be composed of a series of simple-span deck trusses on concrete piers, leading up to a 300-ft. through-truss span on steel towers which provides a 125-ft. vertical shipping clearance over the creek. Foundations are practically complete, and work is beginning on steel superstructure erection.

RARITAN RIVER – This $1,000,000 New Jersey state highway department project, made up of 29 plate girder spans in its 4,400 ft. length, will contain one 250-ft. span and eight 200-ft. spans in a nine-span run of continuous construction arranged in three 3-span groups. The main span vertical clearance will be 135 ft. Pneumatic caisson construction of the 10 river piers is under way, and contract for the 8 south approach piers was let last month. Other contracts will follow to bring completion of the work by June, 1940. The bridge will carry two 24-ft. traffic lanes.

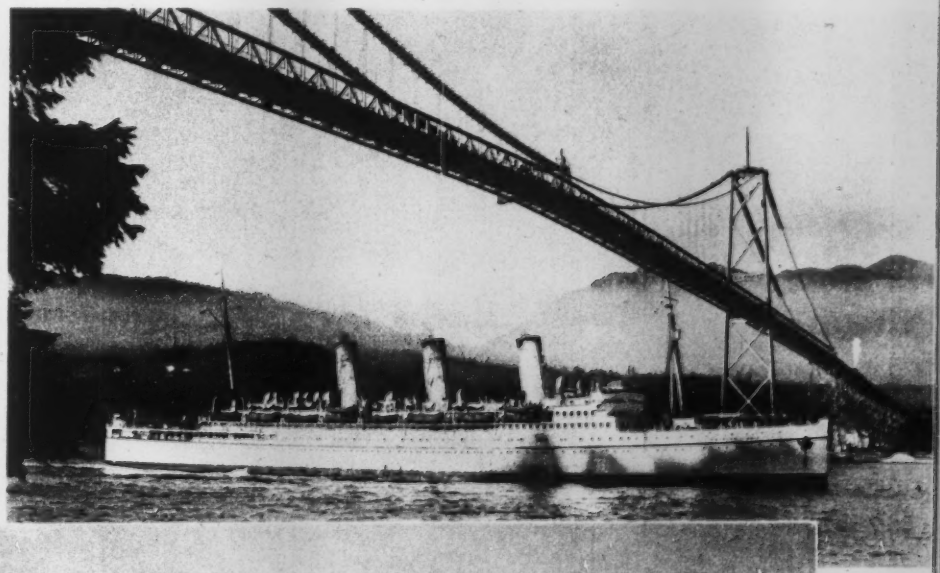
CAIRO – Notable for its multiple-cantilever layout – three through-truss spans of 800, 650 and 650 ft. – this public toll structure across the Ohio River at Cairo, Ill., was completed this year. It replaces a ferry at this important river crossing. The Illinois and Kentucky highway departments financed the approaches.

HENRY HUDSON – An upper deck was added to this 800-ft. hingeless plate girder arch over the Harlem River in New York City this year. The main bridge, opened in December, 1936, proved inadequate to handle the heavy traffic, as the original engineering estimates had predicted. Each deck now accommodates one-way traffic only.

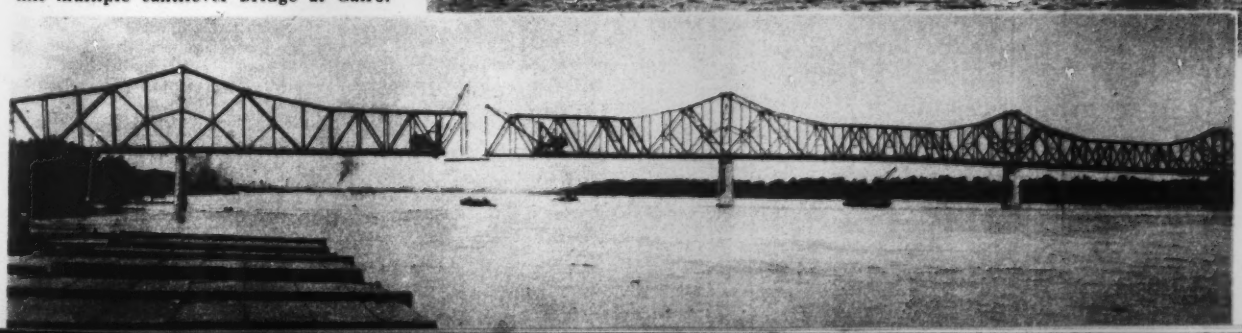
GEORGE WASHINGTON – When this famous Hudson River crossing was being built some 8 years ago, a 2,500-ft. two-lane vehicular tunnel approach under 178th St. was constructed but not fitted for operation. Also, the Manhattan viaduct approach to the bridge was only built to part width and the anchorage facing was omitted. This unfinished work, costing over $1,200,000 was taken up this year and is actively under way. The ventilation building and its equipment as well as the electrical installation in the tunnel are complete. Tunnel work is 75 per cent finished and the paving is 45 per cent complete. The approach viaduct and anchorage facing contract is about half done. The eastern terminus of the tunnel is in High Bridge Park at Amsterdam Ave. From this point to a connection with the Harlem River Speedway a new $3,000,000 viaduct connection is planned.

CHICAGO BRIDGES – Early in 1938 the $1,300,000 Torrence Ave. vertical lift bridge was opened to traffic. In April a $1,330,000 double-leaf bascule at South Ashland Ave. over the Chicago River was completed; it has a 192-ft. span and is 90 ft. wide. The 103rd St., 1,026-ft. viaduct over three railroads was completed as part of a street opening improvement; it cost $650,000 and is of continuous deck girder construction with spans up to 119 ft. long. Plans for North State St. Bridge have been revised to conform to the latest subway plans.

Lion's Gate Bridge, Vancouver, B. C., has a 1,550 ft. main span and 614 ft. side spans.



Replacing a ferry on the Ohio River is this multiple cantilever bridge at Cairo.



GALVESTON CAUSEWAY – This is a connection between Galveston Island and the Texas mainland. The total length of 8,200 ft. is made up of 39 continuous girder spans of reinforced concrete, a draw and flanking spans of 276 ft. and two 33 ft. abutment spans; concrete construction is completed. Financed with PWA money, the construction is being supervised by the Texas state highway department.

BATON ROUGE – Three of the six large piers for the combined highway and railway bridge over the Mississippi River at Baton Rouge have been completed, a third has been sunk to grade and the other two will be down to foundation grade early in the year. The river piers are being sunk through sand islands. Steel erection on the main spans will begin about March 1st. They consist of two 858-ft. cantilevers, one 650-ft. center anchor span and two 490-ft. shore anchors. The east viaduct is complete and the west viaduct is about 30 per cent complete. Grading of approach roads and railway fills is 90 per cent complete. The whole project, costing about $10,000,000, is about 50 per cent complete. It is being built by the Louisiana Highway Commission.

MISSISSIPPI RIVER—Work has just started on three new highway bridges over the Mississippi River, two on the lower river at Natchez and Greenville, Miss., and a third at Rock Island, Ill. The lower bridges are being built as toll projects by the respective cities with RFC loans and PWA grants. The Natchez crossing will consist of four main piers, only one of which is in deep water, sunk 150 ft. below river level, and a cantilever steel superstructure of two 875-ft. and two 575-ft. spans, containing 10,000 tons of steel, all to cost about $3,000,000. At Greenville four deep river piers and three main spans, one 840 ft. and two 640 ft., and long approach structures will cost about $3,400,000 and will require 14,000 tons of steel. Both bridges will carry 24-ft. roadways. The Rock Island bridge will be of five tied-arch steel spans, two 539 ft. long and three 395 ft. It is being built by the city at a cost of $2,500,000.

THOUSAND ISLANDS—Dedicated in August, this 8-mile, $3,000,000 international highway crossing of the St. Lawrence River near Alexandria Bay, N. Y., includes five bridges: two of suspension type with main spans of 800 and 750 ft., respectively; a 348-ft. steel arch; a 600-ft. two-span continuous truss; and a 90-ft. concrete rigid frame, in addition to 3,500 ft. of viaduct. It is a public toll bridge financed by revenue bonds sold privately.

BLUE WATER – Joining Port Huron, Mich., and Sarnia, Ont., this new bridge over the St. Clair River was opened to traffic in the fall. Its main span is an 871-ft. arched cantilever, and there are viaduct approaches at either end, bringing the total length to about 6,500 ft. This is a public toll bridge financed by revenue bonds. Michigan and Ontario highway departments financed the approaches.

MIDDLETOWN—This high-level crossing of the Connecticut River at Middletown, Conn., consisting of two 600-ft. tied arches and long viaduct approaches, was dedicated in August. It was built by the Connecticut highway department and is to be operated as a free bridge. Cost was $3,500,000.

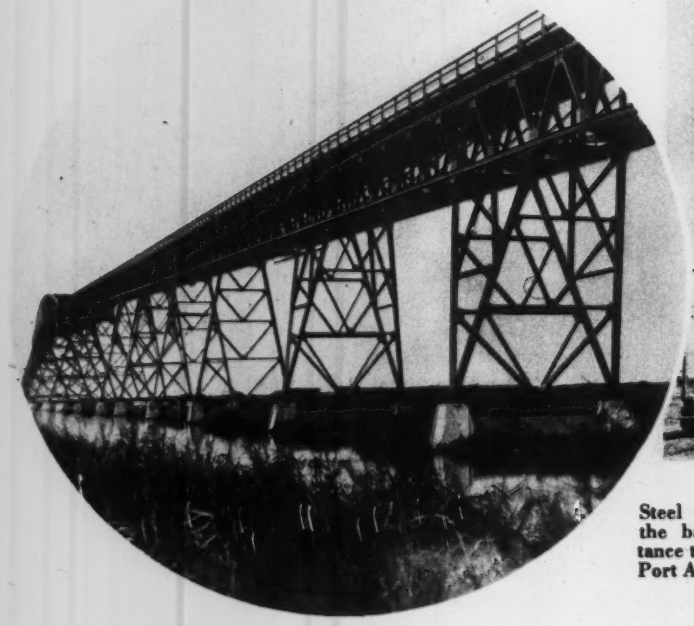
LION'S GATE—At Vancouver, B.C., across the entrance to Burrard inlet, the city's harbor, a suspension bridge with a 1,550-ft. central span and 614-ft. side spans was put in service in November. The structure is a toll bridge for vehicular and pedestrian traffic. Minimum clearance at high water is 200 ft.; the main towers are 360 ft. high.

LAKE WASHINGTON—The Washington (state) Toll Bridge Authority, during 1938, prepared plans and received bids on a highway bridge from Seattle across Lake Washington and Mercer Island. The roadway will be carried on concrete pontoons for about 7,100 ft., a sliding section will open a channel for navigation. The total length of new roadway will be 6.6 mi. including several grade separations and a twin bore tunnel 1,500 ft. long. The cost will be about $8,500,000 to be financed from a 45 per cent PWA grant and a $4,500,000 revenue bond issue. The project will eliminate some 14 mi. and 4,480 deg of curvature from the main route east.

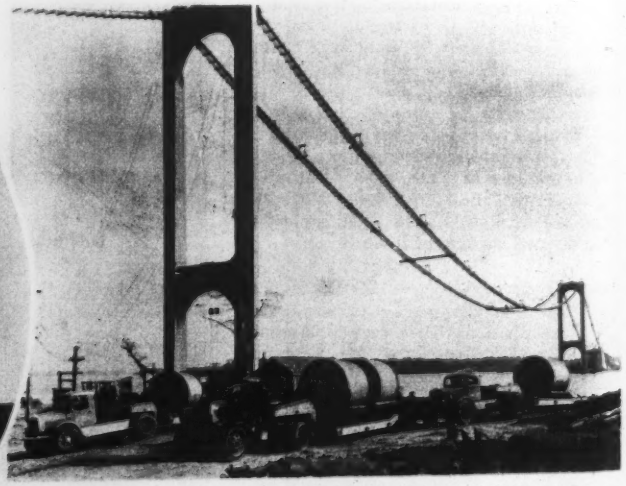
TACOMA NARROWS—Contract was awarded late in November by the Washington Toll Bridge Authority for construction of a $6,000,000 suspension bridge across Puget Sound at the Narrows, near Tacoma. The central span will be about 2,800 ft. (third largest in the world) and there will be two 1,100 ft. side spans. A PWA grant is to be included in the financing program.

NECHES RIVER—Opened to traffic in 1938, this state highway bridge represented one of the major accomplishments of the year. Located near Port Arthur, Texas, the bridge is 7,750 ft. long with a main cantilever span of 680 ft. which provides a 176 ft. vertical shipping clearance. Steel tower supports are spread at the bases as part of the hurricane-resistant design required in the exposed location.

DEER ISLE—This 1,080 ft. span suspension bridge between Sedgwick and Deer Isle on the Maine coast had advanced to the point where floor steel was being hung at the end of the year. Cables are made up of prestressed strands.



Steel tower supports spread at the bases give hurricane-resistance to the Neches River bridge, Port Arthur, Texas.



Cable spinning is brought to completion on the 2,300 ft. Whitestone Bridge in New York.

Spiral approach looking over King's Bluff provides a direct connection between New Jersey highways and the Lincoln Tunnel to New York.

Associated Press building, the twelfth unit to be completed in the Rockefeller Center group.

Photo by Ratcliffe

MISCELLANEOUS

BAYONNE TERMINAL – Dredging and bulkheading for the $1,000,000 railwater terminal being built by Bayonne, N. J., was practically completed at the end of the year. Present work consists of building a long causeway to an artificial island 2,100 x 1,600 ft. built in shallow water in New York Bay off the Bayonne waterfront, and dredging ship channels to the bulkheads forming the island. Warehouses and other wharf facilities are yet to be built. Direct rail connections are to be provided.

RICHMOND PORT – A municipal port development costing $1,750,000 has been started and construction is proceeding on a 1,400 ft. along-side wharf wall, connecting highways and railroad facilities. Bids will soon be taken for dredging of the turning basin, and construction of the transit shed, warehouses and railroad tracks.

LOS ANGELES TERMINAL– The Union passenger terminal, in which Southern Pacific, Santa Fe and Union Pacific Railroads are combining at Los Angeles, is scheduled for completion early in 1939. By the end of the year the project was more than 90 per cent complete. All three railroads are working on track connections and the Southern Pacific Co. is building a $700,000 car yard for servicing equipment.

ARROYO SECO PARKWAY–A new high-speed motor route from downtown Los Angeles to Pasadena, known as the Arroyo Seco Parkway, will provide for two 35-ft. roadways (three lanes each way) with a 6-ft. curbed dividing strip. Work in four divisions, amounting to $1,778,000, is under way; construction already completed amounted to about $4,000,000. Estimated cost of the entire Parkway is $10,227,000.

COLUMBIA PARKWAY – A 7-mile entrance road skirting the Ohio River front, and giving super-highway access from the east to the business section of Cincinnati, was completed in October. The road is a succession of viaducts, half viaducts and retained sidehill cuts. It cost $8,623,000.

BELT PARKWAY – This $25,000,000 thirty-mile parkway encircling the south half of Brooklyn where it skirts Gravesend Bay, Sheepshead Bay and Jamaica Bay, and the east half of Queens, where it skirts the Nassau County line and Little Neck Bay, to a connection with the Whitestone Bridge, was begun by the New York City Park Department this fall and is scheduled for completion by June 1940. In Brooklyn the parkway will ultimately be connected by an elevated highway with the portal of the proposed Battery-Hamilton Ave. tunnel to Manhattan. The project includes some 70 bridges and a 34 ft. three-lane parkway in each direction, separated by a 10-ft. mall. Bridges are to be built full width but only two of the three lanes of roadway will be constructed initially.

WEST SIDE HIGHWAY – The 12-mi. elevated express highway and Henry Hudson Parkway along the Hudson River in Manhattan has been improved by new work at both the north and south ends. At the former, an upper deck was added to the Henry Hudson Bridge over the Harlem River while at the south end progress was made on a 10-block extension of the elevated portion from Canal to Duane Sts. Canal St. is crossed by a 300-ft. through-arch which was brought to virtual completion by the end of the year.

EAST RIVER DRIVE – Work progressed steadily on this important trafficway which is destined to do for the east side of Manhattan what the elevated express highway has done for the West Side. Two sections of the East River Drive are now open. One of these serves as an approach to the Triborough Bridge, while the other forms the lower section of the drive. The remaining 1 miles divides into a number of sections, some of which are under construction. A $10,000,000 section involving double-deck construction is under design.

LINCOLN TUNNEL – Since the opening of the first tube of the Lincoln vehicle tunnel by the Port of New York Authority under the Hudson River between New York City and Weehawken, N. J., in December, 1937, a long loop viaduct has been completed between the west portal and the top of Kings Bluff in New Jersey. Construction of an express highway westward through Weehawken and Union City is under way. Shield driving of the second tube under the river was completed in May, and most of the concrete lining has been placed in the under-river section. The land tunnels for the second tube are also complete. Completion of the second tunnel has been postponed until traffic conditions warrant the need for it.

QUEENS TUNNEL – Driving of the twin vehicle tunnels by the New York Authority under East River at New York City is about 45 per cent complete. Four shields advancing from both the Manhattan and sides of the river are expected to meet in solid rock in the mid-river reef sometime this year. The land sections are also well advanced; that on the Queens approach is nearing completion while the pilot tunnel on the Manhattan land tunnel has just been holed through. The entire project is now 80 percent under contract; the remainder will be placed during 1939.

ROCKEFELLER CENTER – Completion of the 15-story Associated Press Building on the north side of the three-block Rockefeller Center development in New York and start of excavation for a comparably-placed 16-story building on the south side of the plot were events of the year. The latter building, No. 13 in the group, will be unusual in that it will contain six floors for automobile parking, three of these floors below ground and three above.

IRVIN WORKS – Largest industrial plant of the year was the Irvin Works of the Carnegie-Illinois Steel Co. at Clairton, Pa. Said to represent an expenditure of $60,000,000, it is located on a 653-acre hill site in contrast to the river bottom location of previous steel mills. Begun in May, 1937, the plant was placed in operation in December, 1938. In the seventeen buildings, 51 acres are under roof. The plant includes an 80 in. continuous hot strip mill.

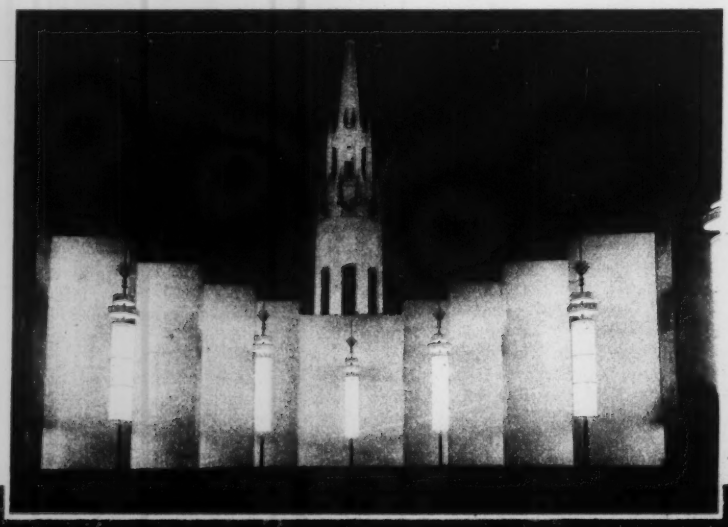
FORD PRESS SHOP – Unusual in both size and design was the new press shop built at the River Rouge plant of the Ford Motor Co. in Dearborn. L-shaped, the building is 1,660 ft. long on one leg and 932 ft. on the other, and has 17 acres under roof, making it the largest factory building in the world. Presses for stamping out car bodies are usually set on ground level but in this building are on a second floor designed for a live load of 2,000 lb. per sq.ft.

NEW YORK SUBWAYS – Work progressed during 1938 on all six contract sections of the Sixth Ave. subway, extending from 8th St. to 53rd St., in New York City, and the construction, costing $38,900,000, was 75 per cent complete. The Board of Transportation is also extending the Fulton St. route of the Independent System in Brooklyn under three contracts awarded in 1938 for 9,700 ft. of subway costing $12,000,000. The Independent System World's Fair branch is almost complete.

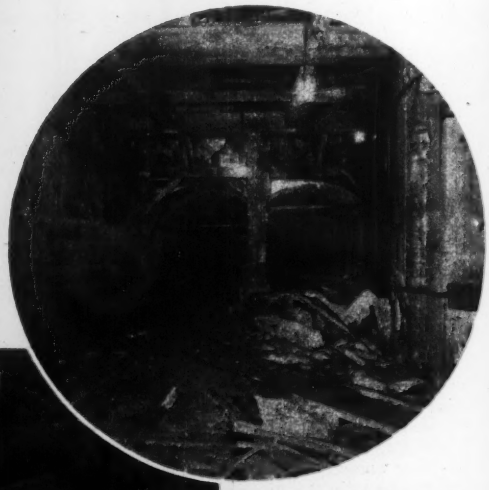
CHICAGO SUBWAYS – Chicago has finally made a start on its $40,000,000 subway system. On Dec. 17 ground-breaking ceremonies initiated construction on the first 3,600 ft. section of deep twin horseshoe tunnels in North State St. Bids on successive short sections are scheduled three weeks apart so that work may proceed in many places at one time to finish within the 18 months required by PWA.

GOLDEN GATE EXPOSITION – At the end of 1938 San Francisco's international exposition construction job was ahead of schedule. The California group of 16 buildings, costing $1,250,000, was well along; the $750,000 Federal building was nearing completion and foreign nations were working on a $3,000,000 program. Concessionnaires are spending about $4,000,000 on construction; seven exhibitors have budgets totaling $2,250,000 to be expended before February 18, the opening date. The overall cost of the exposition now is set at $50,000,000.

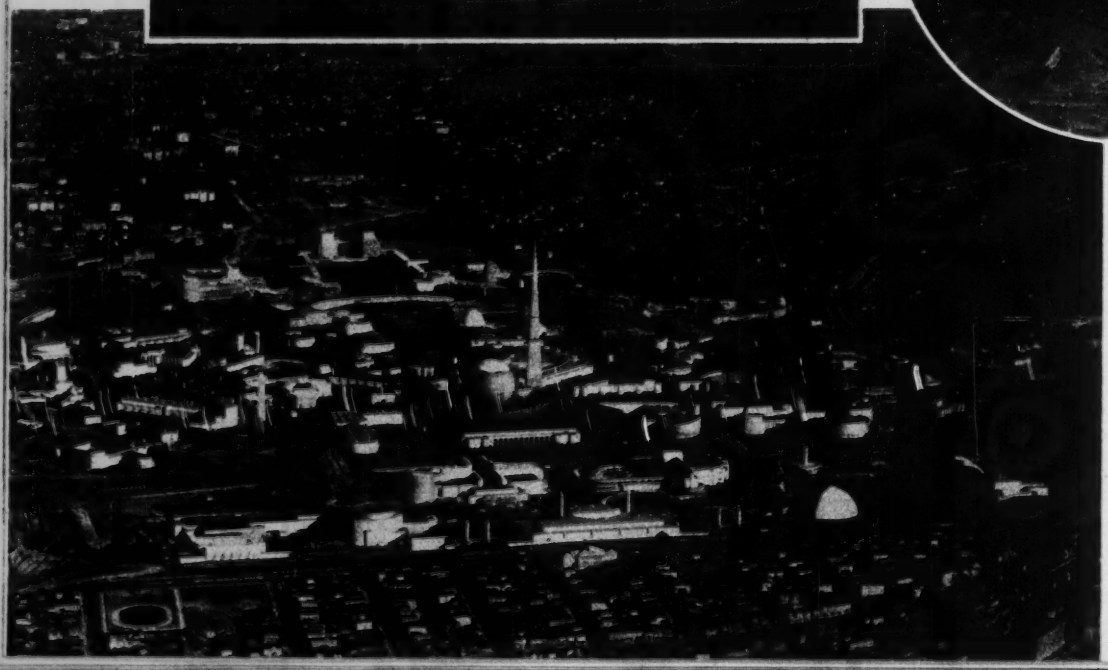
NEW YORK WORLD'S FAIR – Work on all exhibit buildings being put up by the New York World's Fair Corporation and the work on ground, roads and utilities is up to schedule, which calls for opening the fair on April 30, 1939. Buildings to house private exhibitions are well along, most structures being closed in so that work can be carried forward during cold weather. The total investment for structures is placed at $150,000,000.



Vertical "baffles" at the entrance to the Golden Gate International Exposition in San Francisco protect the interior courts from wind.



A new subway takes shape in New York under Sixth Avenue.

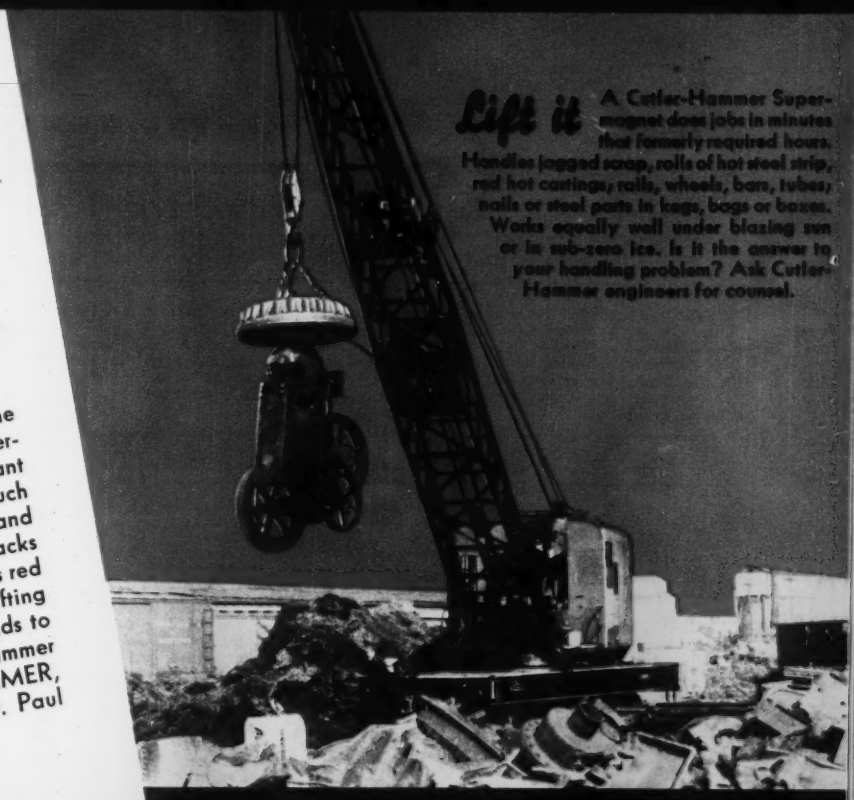


Everything in place and a place for everything at the New York World's Fair which opens in April.

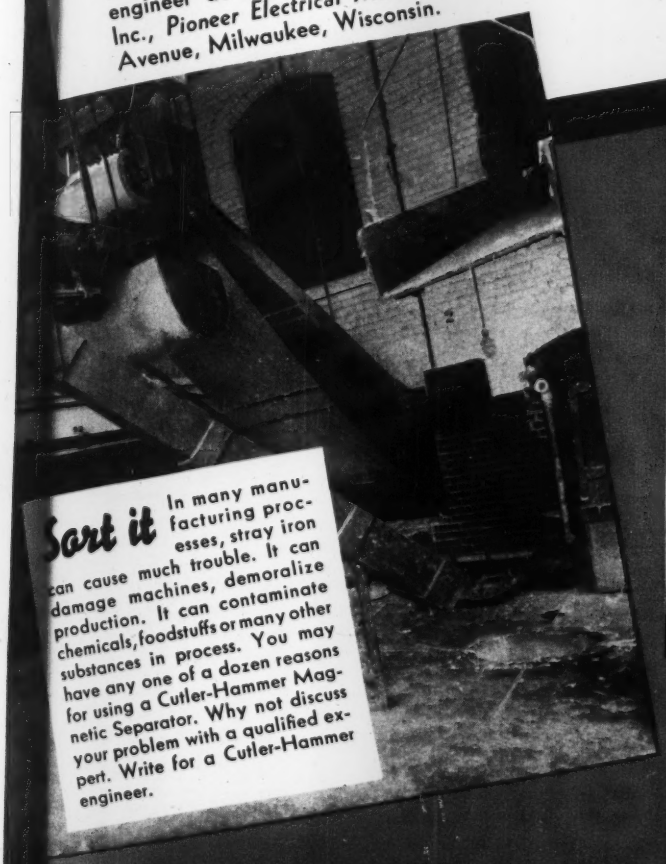
Magnetic Miracles

How you can make easy work of many "impossible" problems

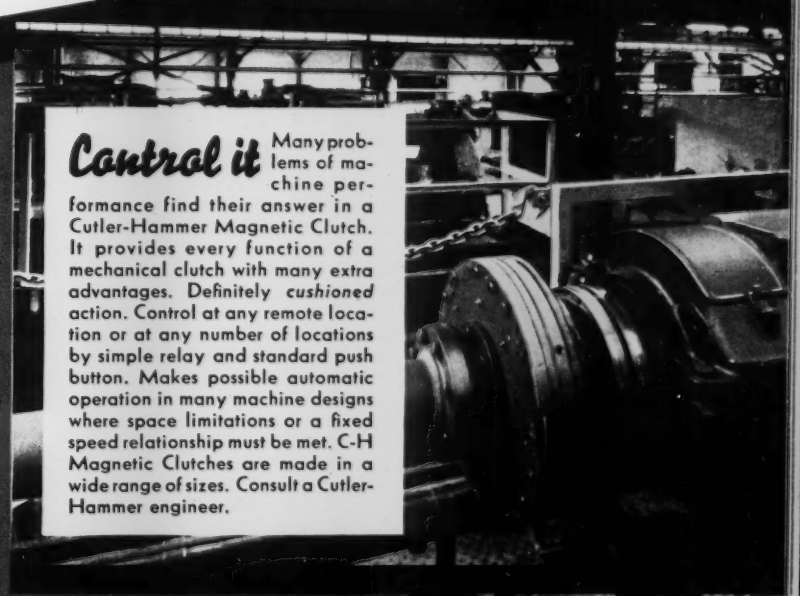
If anyone says these are not miracles, let him look at the savings many industries are making by using Cutler-Hammer electro-magnetic devices. Let him see giant machines clutched and declutched smoothly at the touch of a remote button . . . or parts of machines started and stopped in automatic cycles. Or let him see huge stacks of freezing-cold, jagged scrap metal . . . or castings red hot from the mold . . . wafted about by a C-H Lifting Magnet. Such "miracles" pay handsome dividends to people who find ways to use them. Ask a Cutler-Hammer engineer about your problem. CUTLER-HAMMER, Inc., Pioneer Electrical Manufacturers, 1261 St. Paul Avenue, Milwaukee, Wisconsin.



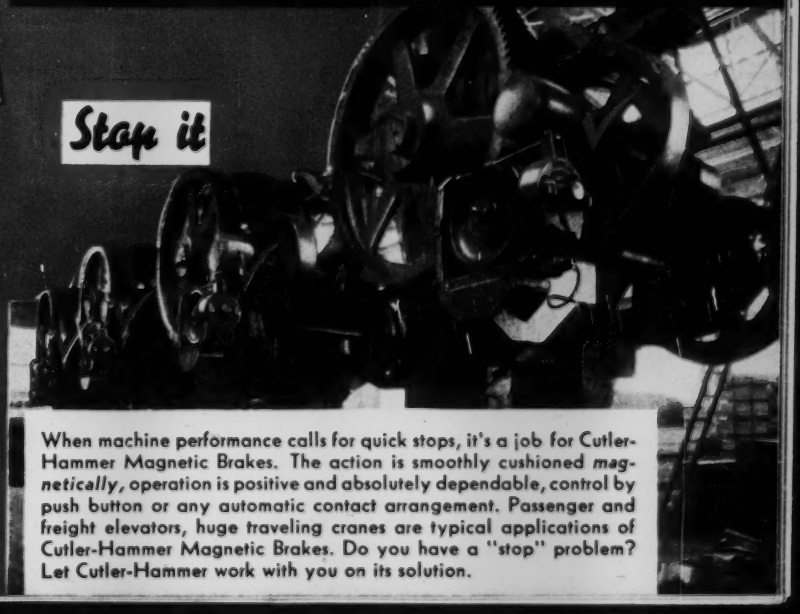
Lift it A Cutler-Hammer Supermagnet does jobs in minutes that formerly required hours. Handles jagged scrap, rolls of hot steel strip, red hot castings, rails, wheels, bars, tubes, nails or steel parts in kegs, bags or boxes. Works equally well under blazing sun or in sub-zero ice. Is it the answer to your handling problem? Ask Cutler-Hammer engineers for counsel.



Sort it In many manufacturing processes, stray iron can cause much trouble. It can damage machines, demoralize production. It can contaminate chemicals, foodstuffs or many other substances in process. You may have any one of a dozen reasons for using a Cutler-Hammer Magnetic Separator. Why not discuss your problem with a qualified expert. Write for a Cutler-Hammer engineer.



Control it Many problems of machine performance find their answer in a Cutler-Hammer Magnetic Clutch. It provides every function of a mechanical clutch with many extra advantages. Definitely *cushioned* action. Control at any remote location or at any number of locations by simple relay and standard push button. Makes possible automatic operation in many machine designs where space limitations or a fixed speed relationship must be met. C-H Magnetic Clutches are made in a wide range of sizes. Consult a Cutler-Hammer engineer.



Stop it

When machine performance calls for quick stops, it's a job for Cutler-Hammer Magnetic Brakes. The action is smoothly cushioned *magnetically*, operation is positive and absolutely dependable, control by push button or any automatic contact arrangement. Passenger and freight elevators, huge traveling cranes are typical applications of Cutler-Hammer Magnetic Brakes. Do you have a "stop" problem? Let Cutler-Hammer work with you on its solution.

BY THE BUILDERS OF

CUTLER-HAMMER

MOTOR CONTROL

C-H

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents

FEBRUARY construction material prices, with minor exceptions, hold at January levels. Short Leaf Southern Pine is 50c. to $1.00 higher on all sizes in Atlanta, and up 50c. on 1 x 8-in. size in St. Louis. 3 x 12-in. Short Leaf Pine timbers are $1.00 lower in Chicago and Detroit. Douglas Fir is off $1.00 on 2-in. sizes in Chicago, and off $1.00 on 2 x 10-in. and 3 x 12-in. sizes in Detroit.

Fabricated structural steel shape and reinforcing bar prices remain unchanged from last month.

Portland cement is up 5c. per barrel in New York City. Sand and gravel are 15c. per cu. yd. higher than a month ago. New York common brick is $2 per M lower than last month.

Slate surfaced roofing is up 5c. per square in Chicago and Minneapolis. Asphalt and tar felt rolls are down 10c. per roll in Chicago, and up 5c. per roll in Minneapolis.

The new Seattle wage rate for common labor on heavy construction work, 50c. per hour, is 10c. per hour lower than the former scale.

CEMENT, AGGREGATES, READY-MIXED CONCRETE—F.O.B. CITY

	PORTLAND CEMENT — Per bbl., carload lots, including 40c per bbl. for bags, cash discount not included			SAND AND GRAVEL — Per ton, carload lots			CRUSHED STONE — Per ton, carload lots		CRUSHED SLAG — Per ton, carload lots, f.o.b. plant		CONCRETE — Ready Mixed 1:2:4, 50 c.y. or more, delivered
	Cloth Bags	Paper Bags	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	
Atlanta	$2.90	$2.65	$2.60	$1.75	$1.85	$1.95	$1.65	$1.75	$1.55	$1.65	$7.75
Baltimore	2.31	2.06	1.91	1.75‡	1.75‡	1.25‡	1.75‡	1.75‡	1.75‡	1.75‡	7.00
Birmingham	2.55	2.30	1.99	1.80	1.80	1.45	1.00	1.00	.90	1.15	5.45
Boston	2.75*b*	2.50*b*	2.30	1.10	1.10	.80	1.10	1.10	....	....	6.75*m*
Chicago	2.60	2.35	2.20	2.00‡*d*	2.00‡*d*	2.00‡*d*	2.00‡*d*	2.00‡*d*	1.25‡	1.25‡	....
Cincinnati	2.47	2.22	2.07	1.20	1.20	1.30	1.80	1.80	....	....	6.60
Cleveland	1.95	1.70	....	1.45*i*	1.45	1.45*i*	1.70*i*	1.70*i*	1.70*i*	1.70*i*	6.65*i*
Dallas	2.30	2.05	1.85	2.00*p*	2.00*p*	1.50*p*	1.69*p*	1.84*p*	....	....	6.40
Denver	3.02	2.77	....	1.20	1.40	.90	....	....	....	....	7.25
Detroit	2.15	1.90	1.70	1.05	1.15	.85	1.45	1.45	1.65‡	1.65‡	6.50
Kansas City	2.56	2.31	2.16	1.85	2.30	1.00	1.91	1.91	....	....	7.90*n*
Los Angeles	2.82*b*	2.62*b*	....	1.68	1.68	1.68	1.68*f*	1.68*f*	....	....	7.00
Minneapolis	3.00	2.75	....	1.00*h*	1.00*h*	.25*h*	1.00*h*	1.00*h*	....	....	7.40*j*
Montreal	....	....	1.58	...	...	1.25‡	.90‡*c*	1.00‡*c*	....	....	7.60*l*
New Orleans	2.41	2.16	....	1.50	1.50	1.25	....	....	....	....	7.25
New York	2.60‡	2.35‡	....	1.40*de*	1.40*de*	.90*de*	1.65*de*	1.75*de*	....	....	7.25
Philadelphia	2.32	2.07	1.87	1.55‡	1.65‡	1.25‡	.....	.....	1.00	1.00	7.95*k*
Pittsburgh	2.44	2.19	1.99	1.80‡	1.80‡	2.10‡	2.25‡	2.25‡	1.50	1.50	8.75
St. Louis	2.55	2.30	. .	1.50‡	1.50‡	1.25/1.50‡	.85*h*	.85*h*	.75*g*	.75*g*	7.50
San Francisco	2.72	2.52	2.20	1.35	1.35	1.35	1.50	1.50	....	....	7.50
Seattle	3.10*o*	2.85*o*	....	1.17*o*	1.17*o*	1.17*o*	1.33*o*	1.33*o*	....	....	7.30*o*

‡ Delivered. *a* 10c. allowed for each returnable bag. *b* 10c. per bbl. off for cash. *c* Plus municipal tax. *d* Per cu. yd. *e* Barge lots alongside docks *f* Crushed granite. *g* F.o.b. Granite City, Ill. *h* F.o.b. plant. *i* Within three miles of Public Square. *j* 5% discount for cash. *k* Discount 35c. 500 to 2000; 70c. 2000 to 5000; 95c. over 5000. *l* Up to 200 cu. yd. *m* 50c. off for cash. *n* 25 c.y. or more. *o* 2% off for cash. *p* 10c per ton off, cash 15 days

CASH DISCOUNTS CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl. for payment within 15 days of date of invoice; in Montreal 5% if payment before 15th.

CURRENT MAXIMUM PRICES RECEIVED AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind.	$1.70	$1.65	Ironton, Ohio	$1.60	$1.55	Richard City, Tenn.	1.80	1.75
Dallas, Tex. (Inc. 5c. tax)	1.80	1.75	Limedale, Ind.	1.70	1.65	Steelton, Minn.	1.80	1.75
Hannibal, Mo	1.70	1.65	Norfolk, Va.	1.65	1.60	Universal, Pa.	1.65	1.60
Hudson, N. Y.	1.75	1.70	Northampton, Pa.	1.55	1.50	Waco, Tex. (Plus 5c. Tax in Texas)	1.75	1.70
Independence, Kans.	1.70	1.65	North Birmingham, Ala.	1.70	1.65			

LOWER PENINSULA, MICHIGAN Uniform carload lot cement price established March, 1937.

PAVING BRICK, BLOCKS, ASPHALT, ROAD OILS—F.O.B. CITY

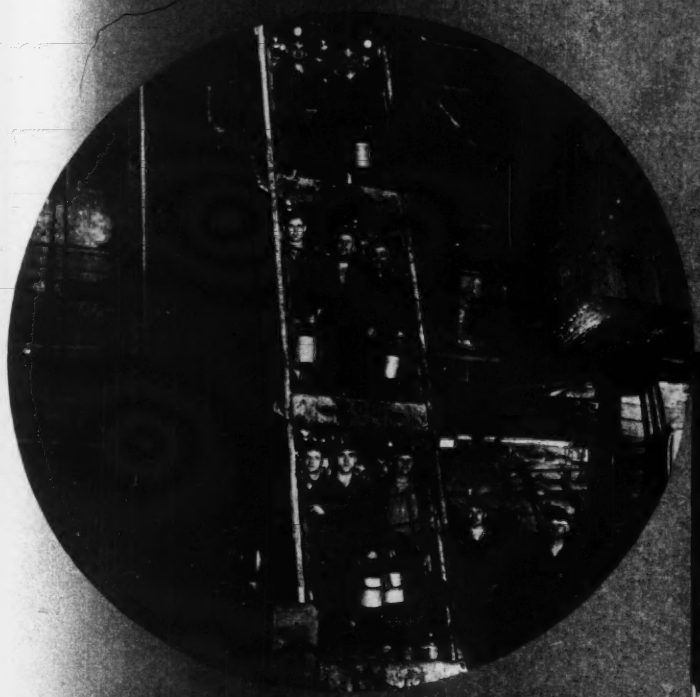
	PAVING BRICKS AND BLOCKS — Granite per M, lots of 50,000, 4x4x8 in.	Brick per M, 3½x4x8½ in., carload lots	Wood per sq. yd., 3½ in. 16-lb. treat	PAVING ASPHALT — Per ton, less than 80 penetration, Tank car	Drums	ASPHALT BINDERS—FLUXES — Per gal., 80–300 penetration, Tank car	Drums	CUTBACK ASPHALT — Per ton, Tank car	Drums	ROAD OILS — Per gal., Tank car	ASPHALT EMULSION (Quick-breaking) — Per gal., Tank car	Drums
Atlanta	$75.00	$39.35	$2.25	$16.60*e*	$21.80*e*	$0.0675*e*	$0.0968*e*	$.0734*he*	$.1053*he*	$0.0584*e*	$0.0834	$0.0834
Baltimore	140.00	44.00‡	2.50	13.00	18.00	.06	.085	.07*h*	.10	.....	.....	.....
Birmingham	.....	25.00	.....	18.20	23.20	.0747	.1047	.0834*h*	.1134*h*	.....	...	.....
Boston	75.00	45.00	3.00	13.00	18.00	.05	.08	.06*h*	.09*h*	.....	.09‡	.12‡
Chicago	140.00	50.00	2.50	14.00	18.00	13.00*g*	17.00*g*	.06*h*	.11*h*	.03	.08	.12
Cincinnati	112.00	37.50	.....	13.31	17.31	.09	.....	16.00	.....	.051	.078	.....
Cleveland	110.00	37.25	2.80	15.25	20.50	.07	.08	.07*h*	.085*h*	.05	.08	.09
Dallas	.....	30.50	.....	12.00	17.00	.04	.07	13.00	18.00	.035	.05/.07	.07/.09
Denver	.....	27.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Detroit	.....	35.00	.....	14.10*f*	20.00*f*	14.00*g*	18.40*g*	14.00	19.70	.0535	.066	.0995
Kansas City	.....	44.00	.....	18.50	23.50	.077	.1075	.077*h*	.107*h*	.057	.11	.15
Los Angeles	.....	50.00	.....	6.50*b*	15.00	6.50*b*	15.00*g*	5.50*b*	.....	.0192	.0525	.1125
Minneapolis	.....	...	1.90*d*	19.20	25.20	.10	.12	19.30	28.80	.056	.....	.....
Montreal	82.50	. ...	3.62	14.60	21.25	.105	.1375	.101*h*	.121*h*	.0935	.13	.16
New Orleans	.....	.....	.....	14.00*a*	19.00*a*	.055	.085	.06*h*	.09*h*	...	.078	.....
New York	.....	68.00	2.90	13.50	18.50	.055	.08	.06*h*	.09*h*	.....	.0725	.1035
Philadelphia	120.00	42.50	2.84	14.00	19.00	.055	.08	.06*h*	.09*h*	.05	.06	.09
Pittsburgh	115.00	40.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
St. Louis	110.00/121.00	37.00	. ...	12.00	17.00	.05	.08	.055*h*	.085*h*	.035	.07	.10
San Francisco	.....	70.00	.....	6.50	15.00	6.50*g*	15.00*g*	7.00	17.50	.025	.0475	.117
Seattle	.....	60.00*c*	.....	13.90	22.90	.....	24.50*g*	9.50/10.50	23.00/24.00	7.75	.0575	.1308

‡ Delivered from warehouse. *a* F.o.b. Baton Rouge. *b* Delivered to purchaser's warehouse. *c* 3½x4x8½ in. *d* 2½ in. 6 to 8-lb. treatment. *e* Local reduction due to 20% reduction intra-state class freight rates, only Georgia affected *f* Mexican. *g* Per ton. *h* Per gallon.

(Continued on page 100)

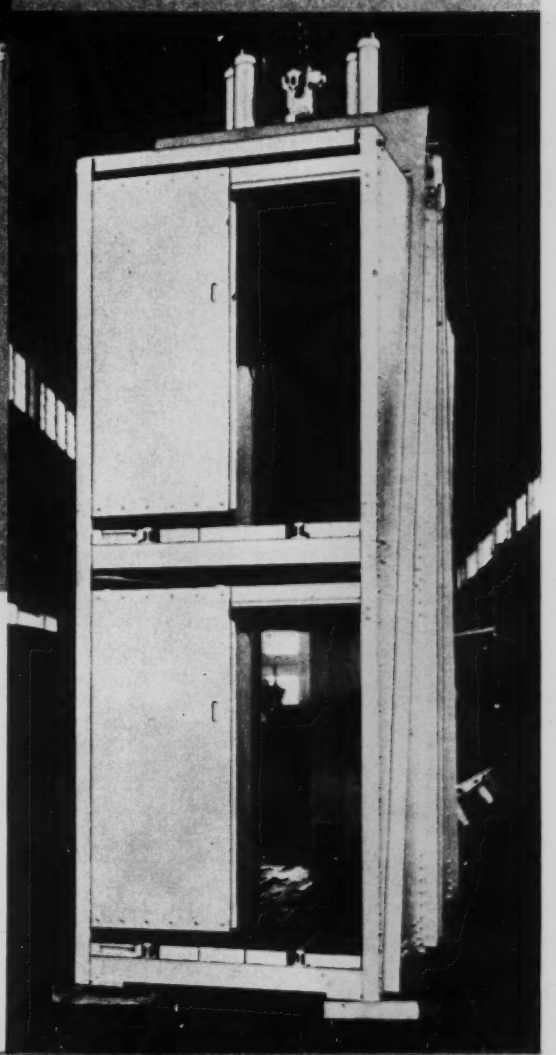
As mines go deeper, tonnage schedules are maintained with

Aluminum Skips and Cages



Aluminum cut the weight of this cage 3,700 pounds; it carries 36 men instead of 24. This saves 13 minutes per shift in getting men in and out of the mine.

5,200 pounds were saved by using Aluminum plate, sheets and shapes for this cage. It carries 50 miners — equals the capacity of the heavier cage.



Aluminum skips and cages increase with safety the efficiency of mining operations. Aluminum's lighter weight allows them to be larger and lighter, so that carrying capacities of man- and material-hoists can be greatly increased. They are made to operate at higher speeds or deeper levels without change in hoisting apparatus.

Alcoa Aluminum Alloys provide high strength and hardness; Aluminum cages and skips have proved their ability to stand up under the abrasion and banging to which they are subjected. The resistance to corrosion provided by Aluminum enables this equipment to defy successfully the attack of acid-bearing moisture so often encountered in mining work.

Ask our engineers how Alcoa Aluminum Alloys can help you develop material handling economies. ALUMINUM COMPANY OF AMERICA, 2108 Gulf Bldg., Pittsburgh, Pa.

ALCOA ALUMINUM

(Continued from page 98)

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS ¼-in. billet b	RIVETS ½-in. structural	WIRE NAILS Base	SHEET PILING Base	STEEL RAILS Per Gross Ton: Standard	Light	Re-rolled	TRACK SUPPLIES: Angle bars	Std. spikes c	Tie plates	Track bolts
Birmingham	$2.10	$2.05	$3.40	$2.45	....	$40.00	$40.00	$39.00	$2.70	$3.00	$2.15	$4.15
Chicago	2.10	2.05	3.40	2.45	$2.40	40.00	40.00	39.00	2.70	3.00	2.15	4.15
Pittsburgh	2.10	2.05	3.40	2.45d	2.40	40.00	40.00	39.00	2.70	3.00	2.15	4.15
Buffalo	2.10	2.05	....	....	2.40	....	....	....	....	....	2.15	....
Cleveland	2.10	2.05	3.40	2.45	....	....	....	....	....	....	....	....
Youngstown	....	2.05	....	....	....	....	....	....	....	3.00	....	....
Detroit	....	2.15‡	....	....	....	....	....	....	....	....	....	....
Gulf ports	2.45a	2.40a	....	....	2.85a	....	....	....	....	....	....	....
Pacific ports	2.70a	2.50a	....	....	2.90a	....	....	....	....	3.00	2.25	....

‡ Delivered. *a* F.o.b. cars dock. *b* For rail steel deduct 15c. from billet prices. *c* Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports, on tie plates alone, Steelton, Pa., on spikes alone, Lebanon, Pa., Richmond, Va. *d* Add switching charge $18 per c.l.

IRON AND STEEL PRODUCTS—F.O.B. WAREHOUSE, PER 100 LB., BASE PRICE

	STRUCTURAL SHAPES Per 100 lb., base price	REINFORCING BARS Per 100 lb., ¾ in., base price: 15 tons or over b New billet	Rail steel	Add $/cwt. for Switch	Del.	EXPANDED METAL LATH Per 100 sq.yd., carload lots: Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING Per 100 s.f., carload lots: 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in., No. 6 & 6 wires Per sq. yd.	SHEET PILING Per 100 lb. base price
Atlanta	$2.74	$2.29	$2.14	.02½	.10	$21.00	$23.00	$1.66	$1.25	$0.1566	$3.04
Baltimore	3.55	2.70	2.55	....	.10	21.00	23.00	1.54	1.17	.1458	2.70
Birmingham	2.10a	2.05	1.90	.02½	.10	19.50	21.50	1.64	1.23	.1548	....
Boston	3.85	2.58	2.43	$20 C.L.	.10	21.00‡	23.00‡	1.60	1.21	.1512	2.94
Chicago	2.10a	2.05	1.90	.03	.05	18.50	20.50	1.51	1.15	.1422	2.40
Cincinnati	3.88	2.31c	2.16c	....	.05	20.50	22.50	1.50	1.14	.1413	....
Cleveland	3.43g	2.05	1.90	.02½	.10	20.50	22.50	1.50	1.14	.1422	....
Dallas	4.15	2.80	2.65	....	....	25.00	27.00	1.77	1.32	.1674	....
Denver	4.21	3.89	3.74	....	....	23.50	25.50	1.81	1.34	.1710	....
Detroit	3.80‡	2.55	2.40	....	.10	22.50	24.50	1.52	1.16	1440	2.85
Kansas City	4.10	2.51c	2.36c	.0	.05	18.50	20.50	1.62	1.22	1539	2.86
Los Angeles	3.50f	2.65	2.50	.02½	.05	23.00	27.50	1.77	1.32	.1674	3.50
Minneapolis	3.80‡	2.38c	2.23c	.0	.10	21.50	24.50	1.64	1.23	1548	2.73
Montreal	3.25	2.65	2.55	....	....	26.68	29.90	2.99	2.08	314	3.95
New Orleans	3.90	2.69	2.54	.05	.10	21.00	23.00	1.67	1.26	.1584	2.87
New York	3.75	2.29	2.14	....	.10	20.50	22.50	1.56	1.19	.1476	2.76
Philadelphia	3.40	2.37	2.22	....	....	20.50	22.50	1.55	1.18	.1467	2.72
Pittsburgh	2.10a	2.05	1.90	.02½	.10	21.50	24.50	1.43	1.10	.1350	2.40
St. Louis	3.82	2.29	2.14	.0	.05	23.50	25.50	1.53	1.16	.1449	2.70
San Francisco	3.95	2.50	2.35	.02½	.10	23.50	25.50	1.77	1.32	.1674	3.00
Seattle	2.70e	2.65e	....	....	....	25.50	27.50	1.77	1.32	.1674	2.90

‡ Delivered. *a* Mill prices. *b* 5–15 tons, add 15c. 1–5 tons, add 25c. Less than 1 ton, add 50c. *c* 20 tons or over Base. *d* Mill price plus freight. *e* F.o.b. dock. *f* Includes delivery in free delivery zone. *g* Less than 1 ton, add 30c; 1 to 5 tons, add 10c.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE Per net ton f.o.b. 6 in. to 24 in.a	VITRIFIED SEWER PIPE Per foot, delivered 8 in., s.s.	12 in., s.s.	ASTM 24 in., d.s.	C13-35 36 in., d.s.	CLAY DRAIN TILE Per 1,000 ft., carload lots, f.o.b. 6 in.	8 in.	CONCRETE SEWER PIPE Per ft., delivered: ASTM C 14-35 12 in.	24 in.	WROUGHT STEEL PIPE Full standard weight. h: 1 to 3 in., Butt Weld Black %	Galv. %	3½ to 6 in., Lap Weld Black %	Galv. %
Atlanta	$46.40	$0.26bc	$0.468bc	$1.69	$4.50e	$85.00	$128.00	$0.45	$1.625	62.2	54.2	59.7	51.2
Baltimore	49.80	.30	.55	2.40	6.25	110.00	170.00	.50	1.75	65.5	57.5	63.0	54.5
Birmingham	42.00	.25	.45	1.625	4.66	85.00	220.00	.40	1.60	62.2	54.2	59.7	51.2
Boston	52.00	.28	.54	2.475	6.67	136.00‡	196.50‡	.50	2.50	64.1	56.1	61.6	53.1
Chicago	50.80	.28	.54	2.25	6.25	100.00‡	150.00‡	.38	1.48	67.0	59.0	63.5	55.0
Cincinnati	49.70	.203	.3915	1.665	5.0225	75.00	120.00	.60	1.90	65.9	57.9	63.4	54.9
Cleveland	51.24	.175	.3375	1.35	4.2025	69.00	108.00	.34	1.45	67.8	59.8	65.3	56.8
Dallas	55.20	.27	.486	1.944	4.70	80.00	100.00	.46	1.57	59.9	51.9	57.3	48.3
Denver	57.60	.39†	.50†	2.10†	....	190.00	220.00	....	....	58.4	50.4	55.7	47.2
Detroit	51.24	.147	.2835	1.215	4.70	66.45	111.40	.25	1.125	66.3	58.3	63.8	55.3
Kansas City	52.12	.30	.54	2.16	5.00	120.00	240.00	.45	1.60	62.9	54.9	60.0	51.5
Los Angeles	52.00	.282†	.508†	2.034†	5.085†	115.50	192.50	1.00	2.00	56.8	47.8	54.3	44.8
Minneapolis	54.20	.24†	.432†	1.728†	4.60†	.....	.....	.70	1.80	64.2	56.2	60.7	52.2
Montreal	60.00	.59	.90	3.15	5.10e	135.00‡	260.00‡	.48	1.92	....	....	....	....
New Orleans	48.38	.26	.48	1.69	....	150.00	220.00	.37	2.10	62.4	54.4	58.8	50.3
New York	49.20	.29	.57	2.25	6.15	.....	.....	.64	1.70	64.9	56.8	62.4	53.9
Philadelphia	47.90	.21	.405	1.75	5.05	100.00	160.00	.54	1.80	65.3	57.3	62.8	54.3
Pittsburgh	52.60	.182†	.351†	1.44†	4.20	97.80	154.20	.85g	2.00g	68.5i	60.5i	66.0i	57.5i
St. Louis	49.48	.28	.504	2.016	3.96	85.00	170.00	.80	2.00	65.1	57.1	62.0	53.5
San Francisco	52.00	.3275d	.5895d	2.358	5.895	107.25	178.75	.45	2.50	....	....	....	....
Seattle	52.35	.35	.63	2.52	6.30	72.00	175.00	.60f	1.60f	....	....	....	....

‡ Delivered. † F.o.b. *a* B. & S. class B and heavier. C/L lots, 200 tons and over Burlington, N. J. (base) $46.00. Gas pipe and class A, $3 per ton additional, 4 in., $3 per ton additional, 30 in. and larger usually $2 per ton less. *b* Double strength. *c* List to dealer. *d* List. *e* 30-inch. *f* Less 5% for cash. *g* Culvert pipe. *h* Discounts from standard list consumers carload prices, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ¼ in., 8¼c.; ⅜ in., 11½c.; 1 in., 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92. *i* Applies also at Lorain, Ohio, mills. Chicago delivered base is 2½ points less. Freight is figured from Pittsburgh, Lorain, O., Chicago Dist. Billing is from point producing lowest price at destination. WROUGHT IRON PIPE: Base price and list prices per ft. same as wrought steel pipe. Discount for Pittsburgh base: Butt-weld — 1 in. and 1¼ in. black 34, galv. 19; 1½ in. black 38, galv. 21½; 2 in. black 37½, galv. 21. Lapweld — 2½ in. to 3½ in. black 31½, galv. 17½; 4½ in. to 8 in. black, 32½ galv. 20.

LUMBER, TIMBER, PLYWOOD—PER M FT. B.M., CARLOAD LOTS F.O.B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR — All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face) *All Fir planks No. 2 common; Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)*								LONG LEAF Y. P. Merchantable grade up to 20 ft.		PLYWOOD Rail freight increment (See note for base price)	
	1x6, S4S	1x8, S4S	2x4, S4S	2x6, S4S	2x8, S4S	2x10, S4S	3x12, Rough	6x12, Rough	12x12, Rough	2x12, Rough	12x12, Rough	⅜"	¾"
Atlanta	$19.50	$19.50	$19.50	$20.00	$20.00	$20.00	$27.00	.....	.....	$38.50	$50.00	$17.75	$21.60
Baltimore	24.00	25.00	24.00	25.00	26.00	27.00	39.00	.....	.....	66.00	70.00	17.35*g*	21.15*g*
	31.00	*31.00*	*31.00*	*31.00*	*31.00*	*31.00*	*39.00*	*$39.00*	*$39.00*	.....	.....		
Birmingham [1]	19.00	19.00	19.00	19.00	19.00	20.00	30.00	30.00	30.00	.....	.....	16.25	19.85
	22.00	22.00	26.00	26.00	26.00	36.00	54.00	.....	.....	48.00	53.00	.....	.....
Boston	28.00 [3]	28.00 [3]	32.00 [3]	32.00	48.00 [1]	60.00 [1]	72.00 [1]	.....	.....	72.00	72.00	17.35*g*	21.15*g*
	28.00	*28.00*	*30.00*	*30.00*	*32.00*	*32.00*	*35.00*	*40.00*	*40.00*	.....	.....		
Chicago	27.00	28.00	30.00	30.00	30.00	30.00	44.00	.....	.....	75.00	75.00	13.15	16.05
	32.00	*33.00*	*35.00*	*35.00*	*35.00*	*35.00*	*40.00*	*39.00*	*39.00*	.....	.....		
Cincinnati	23.75	23.75	25.00	23.25	24.25	26.50	37.50	.....	.....	46.00	49.00	16.25	19.85
	.....	.....	.....	.....	.....	.....	*39.50*	*39.50*	*39.50*	.....	.....	.....	.....
Cleveland *f*	30.00	31.00	36.00	31.00	32.00	40.00	48.00	.....	.....	52.00	62.00 [3]	16.65	20.25
Dallas *e*	28.50	31.50	30.00	26.00	28.50	31.50	55.00	54.00	54.00	64.50	71.00	13.90	16.95
Denver ‡	41.00 [4]	39.00 [4]	43.00 [4]	42.00 [4]	42.00 [4]	47.00 [4]	45.00 [4]	56.00 [4]	64.50 [4]	.....	.....	9.90	12.05
Detroit	24.00	24.00	25.00	25.00	26.00	26.00	34.00	.....	.....	30.50	40.00	16.25	19.85
	.....	.....	.....	*36.00*	*36.00*	*35.00*	*37.00*	*40.00*	*40.00*	.....	.....	.....	.....
Kansas City	27.00	28.50	28.00	26.00	28.00	30.00	35.00	.....	.....	55.00	58.00	12.25	14.95
	28.00	*28.00*	*28.00*	*28.00*	*28.00*	*29.00*	*34.00*	*35.00*	*35.00*	.....	.....	.....	.....
Los Angeles *a*	*35.00*	*35.00*	*35.00*	*35.00*	*36.00*	*36.00*	*42.00*	*46.00*	*42.00*	.....	.....	9.35*gh*	11.35*gh*
Minneapolis *b*	43.00 [4]	43.00 [4]	.....	.....	.....	.....	.....	.....	.....	.....	.....	12.05	14.70
‡	*34.00*	*34.00*	*35.00*	*35.00*	*35.00*	*35.00*	*55.00*	*55.00*	*55.00*	.....	.....	.....	.....
Montreal [7]	*45.00*	*45.00*	*49.00*	*47.00*	48.00	58.00	84.00	.....	.....	135.00	145.00	.....	.....
	40.00	*40.00*	*40.00*	*40.00*	*40.00*	*41.50*	*42.00*	*41.00*	*40.00*	.....	.....	.....	.....
New Orleans	22.00	22.00	20.00	19.00	20.00	22.00	42.00	.....	.....	58.00	65.00	13.90	16.95
	26.00	*26.00*	*28.00*	*29.00*	*32.00*	*30.00*	*32.00*	.....	.....	.....	.....	.....	.....
New York ‡	36.00	37.00	35.00	36.00	36.00	37.00	42.00	.....	.....	77.50	80.00	17.35*g*	21.15*g*
‡	.....	.....	*40.00*	*40.00*	*40.00*	*40.00*	*40.00*	*42.50*	*42.50*	.....	.....	.....	.....
Philadelphia	23.50	24.00	25.00	25.00	26.00	26.50	28.50	.....	.....	54.00	56.00	17.35*g*	21.15*g*
	34.00	*35.00*	*38.00*	*37.25*	*36.50*	*36.50*	*41.75*	*31.50*	*31.50*	.....	.....	.....	.....
Pittsburgh	38.10	39.90	47.05	42.00	45.65	46.90	59.70	.....	.....	.....	.....	17.00	20.70
	51.90	*49.60*	*49.60*	*49.00*	*48.90*	*49.25*	*66.55*	*66.55*	*66.55*	.....	.....	.....	.....
St. Louis ‡*c*	31.50	33.00	31.00	30.00	31.00	32.50	49.00	*51.00*	*51.00*	74.00	73.00	13.90	16.95
San Francisco *d*	*19.00*	*19.00*	*19.00*	*19.00*	*19.00*	*19.00*	*23.00*	*23.00*	*23.00*	.....	.....	7.30*g*	8.90*g*
Seattle	*20.00*	*20.00*	*20.00*	*20.00*	*20.00*	*20.00*	*26.00*	*26.00*	*26.00*	.....	.....	0.00	0.00

Bold Face type, Southern Pine. *Italics, Douglas Fir.* [1] Long leaf. [2] Roofers' N. C. Pine. Spruce. [4] Native. [5] Western Pine, No. 3 Common. [7] Pine. [8] Norway Pine. ‡ Delivered. *a* Yard prices. *b* Contractors discount in Minneapolis and St. Paul discontinued May 21, 1938. *c* 5M ft. or less. *d* At ship's tackle. *e* 10% discount taken off.

Note: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, sanded 2 sides, water resistant glue, car load lots, delivered per 1000 sq. ft. surface. Base price — Seattle: ⅜", $70.09. ½", $77.96. For other centers add rail freight increment from table for proper size. Add: for form oil treatment, $2.50 per M. sq. ft.; for mineral paint sealed edges, $1.00 per M; for resin dipped treatment, $10.00 per M. *g* Lower rate by water shipment. *h* 50,000 lb. minimum

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS — Discounts from latest jobbers list, Sept. 15, 1928 Single or Double Thickness A quality	B quality	EXPLOSIVES — Per lb. 40% Ammonia Gelatin in 50-lb. cases delivered in 200 lb. lots*
Atlanta	88%	88%	$0.16
Baltimore	88%	87%	.16
Birmingham	89%	90%	.115
Boston	87%	89%	.16
Chicago	79%*c*	79%*c*	.16
Cincinnati	89–10%	91–10%	.16
Cleveland	85–10%	85–10%	.20
Dallas	80%	80%	.175
Denver	85%	86%	.16*e*
Detroit	87–10%	89–10%	.16
Kansas City	78–10%	79–10%	.165
Los Angeles	90%*a*	90@40%	.1675
Minneapolis	76%*d*	76%*d*	.165
Montreal	70–10%*b*		.18†
New Orleans	86%	88%	.17
New York	89%	90%	.23*f*
Philadelphia	89–10%	90–10%	.16
Pittsburgh	86%	87%	.1525
St. Louis	86–10%	87–10%	.165
San Francisco	78%	83%	.165
Seattle	86%	90%	.1675

Price of 60% Ammonia Gelatin is $0.015 per lb higher than 40%

a Disc. from list Aug. 1, 1929. *b* Also less 6% tax exemption. *c* Discounts from jobbers list, Nov. 16, 1938. *d* Discount from jobbers' list Aug. 15, 1938.

* Urban prices influenced by service charges or local storage and delivery regulations, do not consistently reflect quantity prices in less congested areas. *e* F.o.b. Louviers, Colo. *f* In boroughs of Kings, Queens and Richmond, and in Manhattan south of Canal Street, add delivery charge of $6.00 per trip. † F.o.b.

40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)

	C/L 20,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla.	$0.115	$0.14	$0.16
W. of Miss., to Rocky Mtn. States, and Fla.	.12 –.13	.145 –.16	.165 –.18
Rocky Mtn. States	.12 –.1425	.14 –.155**	.16 –.175**
Pacific N. W. States	.1175–.13	.1475–.16	.1675–.18
Pacific S. W. States	.1150–.1275	145 –.1525	.165 –.1725

** F.o.b. Louviers, Colo., or Butte, Mont.

PILES, TIES—F.O.B.

PILES

Prices per linear foot, pine, with bark on, f.o.b. New York; delivered from barge 1¼ to 2*c*. per ft. additional:

Dimensions	Points	Length	Short Leaf — Barge	Short Leaf — Rail
12 in. at butt	6 in	30 to 50 ft.	$0.18	$0.195
12 in.—2 ft. from butt.	6 in.	50 to 59 ft.	.225	.24
12 in.—2 ft. from butt.	6 in.	60 to 69 ft.	.23	.255
14 in.—2 ft. from butt.	6 in.	50 to 69 ft.	.24	.265
14 in.—2 ft. from butt.	6 in.	70 to 79 ft.	.28	.275
14 in.—2 ft. from butt.	5 in.	80 to 85 ft.	.40	.415
14 in.—2 ft. from butt.	5 in.	85 to 89 ft.	.42	.482

RAILWAY TIES

Prices f.o.b., per tie, for carload lots:		6" x 8" x 8' Untr.	6" x 8" x 8' Tr.	7" x 9" x 8' 6" Untr.	7" x 9" x 8' 6" Tr.
Boston	Oak	$1.10	....	$1.60	....
	Pine	1.25	$1.90*a*	1.85	$2.75*a*
New York	S.L. Sap Pine	1.05/1.15	1.90*g*	....	2.35*g*
	Mixed Oak	1.50	1.35	1.85	....
Birmingham	White Oak	.85	1.50*a*	1.35	1.70*a*
	Southern Pine	.55*b*	1.10*ab*	.70	1.30*a*
Chicago	Oak	....	1.65*a*	....	2.25*a*
	Southern Pine	....	1.53*a*	....	2.13*a*
Los Angeles	Douglas Fir	.64	1.38*a*	.90	1.80*a*
Philadelphia	Red Oak	1.10	....	....	2.40*a*
St. Louis	White Oak	.90	....	1.25	....
	Red Oak	.90	1.40*a*	1.25	1.85*a*
	Sap Pine or Cypress	.80	....	1.15	....
San Francisco	Douglas Fir	.80*bef*	....	....	1.85*cef*
Montreal	Birch or Maple	.65	1.05*a*	.75	1.35*a*

Tr.—Treated; Untr.—Untreated. *a* Creosoted. *b* 6" x 8" x 8' 6" *c* Empty cell. *d* Zinc. *e* Green. *f* At ships tackle. *g* Dense pine

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder, in drums, f.o.b. works, per 100-lb	$2.00–2.85
Chlorine cylinders, per lb. delivered	.055
Calcium chloride, 77–80%, flaked, in 400-lb. drums or 100-lb. moisture proof bags, f.o.b. works, freight equalized with points of competition, per ton	22.00–35.00
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb	1.40
Soda ash, 58%, in paper bags, per 100 lb. dense	1.10
Sulphate of aluminum, commercial, in 100-lb. bags, per ton	23.00
Sulphate of copper, in bbl., per 100-lb	4.50

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	STRUCTURAL CLAY TILE — PARTITION — SCORED Per M. lots of 2,000 pieces or over, 3x12x12 in.	4x12x12 in.	8x12x12 in.	STRUCTURAL CLAY TILE — LOAD BEARING — SCORED Per M. lots of 2,000 pieces or over, 8x12x12 in.	10x12x12 in.	12x12x12 in.	BRICK Per M. in quantity, Common backing	Straight hard	LIME Per ton, Hydrated finishing	In paper Common hydrated	Carload lot Pulverized or lump
Atlanta	$100.00	$120.00	$200.00	$230.00	$240.00	$250.00	$11.50	$16.00	$24.00	$15.50	$15.50
Baltimore	74.00	80.00	165.00	195.00	250.00	300.00	13.00*k*	16.00*k*	14.00	15.00	22.00
Birmingham	78.75	84.00	157.50	189.00	201.25	242.00	15.00	19.00	3.00*o*	1.75*o*	2.25*o*
Boston	90.75*ab*	96.80*ab*	181.50*ab*	205.70*ab*	266.70*ab*	304.80*a*	17.00*i*	20.00*i*	19.00	13.00	3.10*p*
Chicago	68.10	72.60	135.90	185.70	234.90	268.10	11.00	12.00	15.00	14.40	12.20
Cincinnati	56.45	60.40	115.25	138.70	166.50	206.40	16.00	16.00	15.90	13.00	.....
Cleveland	52.50	56.00	105.00	126.00	170.00	194.50	15.50	15.50	15.20*j*	12.80*j*	2.65*m*
Dallas	62.50	67.00	135.00	162.00	177.00	263.00	11.50*i*	13.50*i*	19.00	15.00	.95*m*
Denver	78.50	88.00	141.50	166.50	196.00	225.50	12.00	15.50	28.00*j*	17.00*j*	35.00*j*
Detroit	68.90	73.50	137.80	175.50	232.00	265.00*e*	16.00	17.00	13.50	11.25	12.75
Kansas City	64.50	66.50	86.00*c*	125.50	159.75	186.25	14.00	24.00	19.10	12.80	10.70
Los Angeles	73.50†*r*	89.50†*r*	128.00*c*†*r*	210.00†*r*	368.00†*r*	460.00†*r*	12.00	14.00	18.70	.....	19.70
Minneapolis	80.35	85.70	146.00	192.85	176.20*d*	245.20*d*	13.10	15.10*g*	21.00	16.00	19.00
Montreal	64.00*a*	77.00*a*	141.00*a*	77.00*a*	128.00*a*	.....	21.00	31.00	24.60	16.00	1.75*o*
New Orleans	72.00	72.00	135.00	162.00	210.00	260.00	14.00	.....	18.30	12.08	14.10
New York	87.00	93.00	128.00	193.30*h*	238.80*h*	295.60*h*	13.00	.....	20.00	15.00	18.00
Philadelphia	77.40	82.50	154.70	185.70	229.90	284.60	11.00*s*	18.00*s*	15.50*q*	10.05	10.55
Pittsburgh	58.40	62.40	116.85	124.00	153.00	193.75	17.00	25.00	17.70	15.20	2.57*m*
St. Louis	62.00	65.00	120.00	180.00	234.00	280.00	16.00	17.00	22.00	16.00	2.30*lm*
San Francisco	84.00	94.50	225.00	.....	.....	.....	14.00	17.00	.55*o*	.40*o*	2.05*m*
Seattle	100.00	110.00	220.00	.....	.....	.....	17.50*f*	17.50*f*	20.00*s*	20.00*s*	20.00*s*

† F.o.b. *a* Smooth. *b* Carload lots delivered to job. *c* 6 x 12 x 12 in. *d* Not load bearing. *e* 48 lb. tile. *f* Less $1.00, ½ cash 15 days, balance 30 days. *g* Selected common. *h* F.o.b. Perth Amboy, N. J. *i* 50c per M. off for cash. *j* LCL. *k* $1.00 discount if paid in 10 days. *l* Lump. *m* Per bbl., 180 lb net. *n* Per sack 100 lb. *o* Per bbl., 200 lb. *p* 280 lb. bag. *q* 15-ton cars. *r* 5% discount 10 days. *s* 2% off cash. *t* 5½ x 8 x 12.

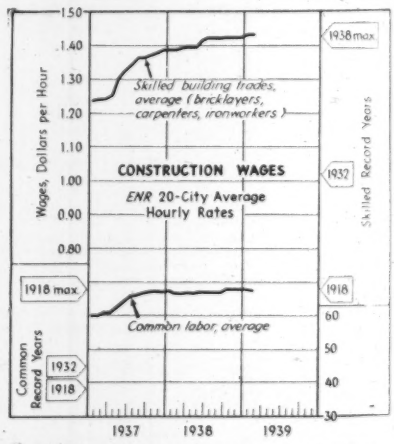
PAINT, ROOFING—F.O.B. CARLOAD LOTS

	RED LEAD Per 100 lb. in 600-lb. (Approx.) bbl. Dry *a*	WHITE LEAD Per 100 lb. in oil	READY-MIXED PAINT Per gal., drums Graphite *b*	Aluminum *c*	Ferric Oxide *d*	ROOFING SUPPLIES Carload lots f. o. b. factory Rolls, slate surfaced, 85–90 lb., per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 350 lb. bbl. per ton
Atlanta	$8.50	$12.125	$1.30	$2.25	$1.20	$1.71	$1.65	$1.65	$.36	$26.00
Baltimore	8.25	11.75	1.45	2.25	1.70	2.16	2.75	2.75	.40	27.50
Birmingham	8.50	12.125	2.35	2.35	1.85	2.07	2.03	2.03	.45	30.37
Boston	8.25	11.75	1.80‡	2.20‡	1.80‡	1.75‡	1.90*h*‡	1.90*h*‡	.40‡	20.00‡
Chicago	8.25	11.75	1.88	2.53	1.56	1.58*hf*	1.49*hf*	1.49*hf*	.26*f*	21.00*f*
Cincinnati	8.25	11.75	1.45	2.50	1.40	2.40	2.39*h*	2.39*h*	.36	21.00
Cleveland	8.25	11.75	1.90	2.60	1.40	1.45	1.50*h*	1.50*h*	.36	21.00
Dallas	8.25	12.50	1.80	1.95	....	2.75*h*	2.50*h*	2.50*h*	.60	.....
Denver	8.75	12.25	....	....	....	2.45	4.00	3.00	.35	28.00
Detroit	8.25	11.75	2.00	3.00	1.75	2.40	3.25	3.25	.35	29.00
Kansas City	8.25	11.875	2.15*g*	2.40*g*	1.67*g*	1.93	2.09	2.09	.25	25.00
Los Angeles	8.50	12.25	1.60	2.25	2.30	2.10	1.50	....	.45	.....
Minneapolis	8.25	11.875	....	....	....	1.45*i*	1.50*hi*	1.50*hi*	.29	21.00
Montreal	9.75	9.00	2.25	2.80	2.35	3.05	1.85	2.15	.95	10.80*k*
New York	8.25	11.75	1.80	2.45	1.48	1.45	1.50*h*	1.50*h*	.23	24.00
Philadelphia	8.25	11.75	....	....	....	1.92*e*	1.99*he*	1.99*he*	.41*e*	21.00
Pittsburgh	8.25	11.75	1.05	1.95	.80	1.95	1.94*h*	1.94*h*	.34	26.00
St. Louis	8.25	11.75	1.70/1.90	2.50/2.75	1.50/1.90	1.45	1.50	1.50	.23	21.00
San Francisco	8.50	12.00	1.80	2.75	1.10/2.00	1.66	1.90	1.90	.325	20.50
Seattle	8.50	12.25	1.80	3.00	2.20	2.02	1.43/2.10	2.60	.54	24.10*j*

‡ Delivered. Note: Red lead in oil 50c. higher than white lead in oil. *a* Red lead prices change frequently due to pig lead price changes. *b* U. S. War Dept. Spec. 3-49A. *c* ASTM Spec. D266-31. *d* 80% maximum ferric oxide. *e* Subject to 25% discount. *f* Distributors' price to contractors. *g* 5 gal. can. *h* Per roll, 65 lb. *i* Minneapolis and vicinity. *j* Asphalt pitch. *k* 550 lb. barrel.

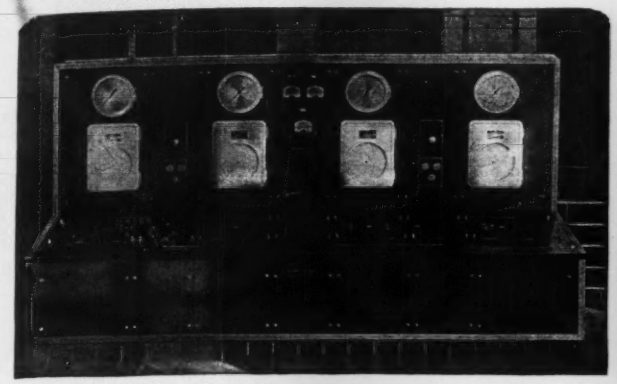
SKILLED AND COMMON WAGE RATES—PER HOUR

	Bricklayers	Carpenters	Struct. Iron Workers	Hoisting Engineers	Plasterers	Common Labor Building	Common Labor Heavy Const.
Atlanta	$1.25	$1.00	$1.25	$1.00/1.25	$1.25	$0.40/.50	$0.40/.50
Baltimore	1.50	1.25	1.50	1.50	1.25	.50	.50
Birmingham	1.50	1.125	1.25	1.125	1.00	.30/.40*a*	.30/.40*a*
Boston	1.50	1.375	1.80	1.375	1.625	.60/.85	.60/.85
Chicago	1.70	1.625	1.70	1.625	1.70	1.025	1.025
Cincinnati	1.00/1.625	.70/1.35	1.40	1.00/1.40	1.00/1.625	.60/.75	.60/.75
Cleveland	1.625	1.375	1.50	1.50	1.50	.90	.90
Dallas	1.50	1.25	1.25	1.00	1.50	.40	.40
Denver	1.50*b*	1.5*ub*	1.43*b*	....	1.43*b*	.718*b*	.718*b*
Detroit	1.50	1.25	1.50	1.50	1.55	.60/.80	.60/.80
Kansas City	1.625	1.375	1.50	1.50	1.575	.85	.45/.50
Los Angeles	1.25	1.10	1.375	1.375	1.50	.625	.625
Minneapolis	1.375	1.25*d*	1.50	1.40	1.50*e*	.85	.85
New Orleans	1.00	1.00	1.25	1.00	1.00	.40	.40
New York	1.886*b*	1.75*b*	1.925	2.00*b*	2.00*c*	1.031	.875/.95
Philadelphia	1.65	1.25	1.50	1.50	1.565	.60	.60
Pittsburgh	1.75	1.50	1.50	1.25	1.75	.80	.70
St. Louis	1.50	1.25	1.75	1.57/2.00	1.58	.45/.875	.45/.875
San Francisco	1.75*c*	1.25*f*	1.50	1.50	1.60*c*	.81	.65
Seattle	1.60*c*	1.25*c*	1.50*c*	1.50*c*	1.60*c*	.90*c*	.90*c*
Montreal	.70	.60	.60	.55	.67	.35	.40



a PWA *b* 7 hr. day. *c* 6 hr. day. *d* 35 hr. wk. *e* 30 hr. wk. *f* Working under "stop-gap" agreement.

ENR Skilled Average: (Bricklayers, Carpenters, Iron workers) **$1.432**
ENR Common Average: $0.680



Bailey Automatic Control System for extracting excess sludge from return sludge lines at Easterly Sewage Treatment Works, Cleveland, Ohio; George B. Gascoigne, Consulting Sanitary Engineer.

SEWAGE PLANT CONTROL

The above photograph is part of an Excess Sludge Control System, which draws a constant flow of excess sludge from each of four return sludge lines. It operates on a time cycle so that sludge is drawn from one line only at a time, with the control automatically opening and closing cone valves so that each return sludge line furnishes excess sludge for a definite period during each cycle.

This control installation, which is designed to operate by compressed air and electricity, is only one of the many applications for control in the Sewage Treatment or Water Supply Plant. Bailey Engineers are not limited to one method or type of control. They propose and furnish control best suited to your application, regardless of whether that control is operated by air pressure, hydraulic pressure, electricity or by a combination of these methods. In each case, the Bailey Venturi Tube Meters serve as a basis for operation of the control.

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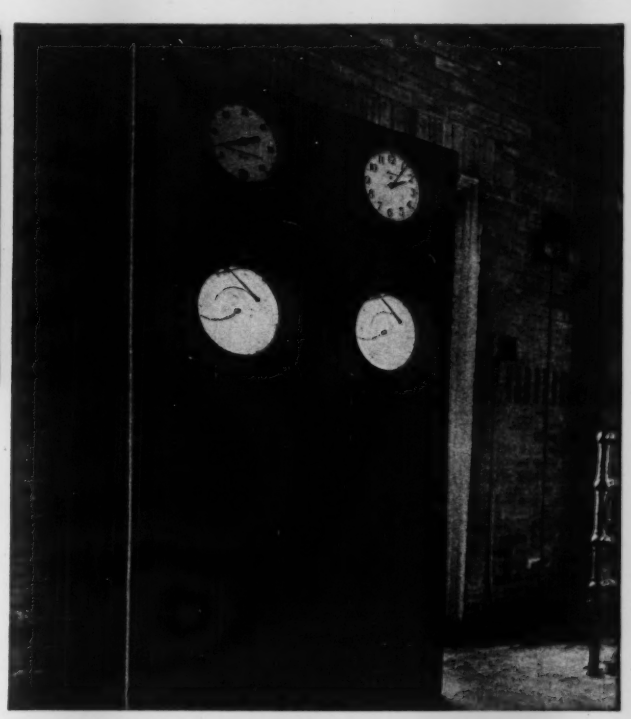

Bailey Registers in the Sewage Treatment Plant, Walden, New York. These Registers use Venturi flumes as primary elements.

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CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

PONTOON BRIDGE, SEATTLE

OWNER: Washington Toll Bridge Authority, Olympia. NOTE: Tabulations on this page are of Units 6, 7, 8 of the Lake Washington pontoon bridge project, Seattle. The first five schedules were published last week, together with a map and description of the job. Next week, the remaining three schedules will be run. The following is a summary of the jobs covered on this page:

Unit No. 6, western side of Mercer Island, grading and paving, 6,773 ft.; unit No. 7, bridges or structures on Mercer Island, reinforced concrete grade separations; unit No. 8, eastern side of Mercer Island, grading and paving, 7,741 ft.

Labor rates stipulated for the job are as follows: skilled $1.25 per hr.; semi-skilled, 75¢ per hr.; common, 50¢ per hr. (These rates are considerably below actual rates. (See *ENR*, January 26, 1939, page 7).

UNIT NO. 6

Contract time, 270 days; high bid of nine, $360,560.

LOW BIDDERS:

1. N. Fiorito Inc., Seattle $265,485
2. Fiorito Bros. Inc., Seattle (contract) *265,742
3. Acme Const. Co. & Macri Bros., Seattle 271,640

* Adjusted bid, $257,332.

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Uncl. excav. incl. haul of 600 ft	249,910 c. y.	.25	.25	.23
2. Structure excav. incl. haul of 600 ft	1,450 c. y.	1.50	1.00	1.00
3. Class "D" excav. incl. haul of 600 ft	1,790 c. y.	1.50	.75	1.00
4. Overhaul on above	88,470 c. y. stas.	.01	.01	.01
5. Overhaul on above	93,150 c. y. mi.	.12	.10	.10
6. Selected roadway borrow	36,200 c. y.	.85	.70	.75
7. Gravel backfill	100 c. y.	3.50	3.00	3.50
8. Slope treatment	75,200 l. f.	.08	.08	.04
9. Finishing roadway	138 stas.	10.00	7.00	10.00
10. Screened gravel surf	360 c. y.	2.00	2.00	1.30
11. Conc. pavt. 10 in. x 7 in. x 10 in. std. 14 day mix	33,220 s. y.	1.75	1.92	2.00
12. Conc. pavt. 9 in. x 6½ in. x 9 in. std. 14 day mix	4,570 s. y.	1.65	1.80	1.90
13. Conc. pavt. 10 in. x 7 in. x 10 in. high early str	140 s. y.	1.95	2.10	2.20
14. Conc. pav. 9 in. x 6½ in. x 9 in. high early str.	1,520 s. y.	1.85	1.98	2.10
15. Conc. pavt br. apprch. slabs	280 c. y.	10.00	10.00	12.00
16. Dowel bars with rubber caps	5,840 ea.	.22	.19	.22
17. Dowel bars without caps	15,880 ea.	.15	.11	.14
18. Pav. reinf	51,420 lb.	.045	.05	.06
19. Spl. conc. curb des. "A" — std. mix	430 l. f.	.50	1.00	1.50
20. Spl. conc. curb des. "B" — std. mix	846 l. f.	.45	.85	1.00
21. Integral conc. curb.— std. mix	2,620 l. f.	.20	.18	.25
22. Conc. curb & gutter — std. mix	9,000 l. f.	.75	.70	.90
23. Std. gutter — std. mix	7,700 l. f.	.60	.48	.65
24. Conc. sidewalk — std. mix	4,770 s. y.	1.25	1.20	1.40
25. Pave. header No. 3	170 l. f.	.75	1.00	1.00
26. Conc. cl. "B"	95 c. y.	20.00	25.00	22.00
27. Conc. bridge rail	1,175 l. f.	4.00	4.00	4.75
28. Conc. class "C"	15 c. y.	25.00	20.00	20.00
29. Hand placed riprap	220 c. y.	8.00	8.00	5.00
30. Cable guard rail des. No. 6	8,130 l. f.	.65	.60	.65
31. Std. guard rail type No. 3	160 l. f.	.75	.75	.65
32. Conc. right of way markers	41 ea.	1.50	1.75	2.00
33. Spl. conc. catch basin des. No. 1	6 ea.	50.00	25.00	40.00
34. Spl. conc. inlet with C.I. frame & grate	43 ea.	25.00	30.00	40.00
35. Spl. conc. catch basin des. No. 2 switch C.I. frame & grate	6 ea.	50.00	30.00	40.00
36. Remov. drop inlet (1)	L. S.	15.00	5.00	30.00
37. Resetting drop inlet (1)	L. S.	15.00	25.00	30.00
38. Remov. pav't	1,220 s. y.	.25	.20	.20
BITUMINOUS SURFACE TREATMENT				
39. Preparation of untr. roadway	1 mi.	450.00	200.00	250.00
40. Bit. mixture-plant mix cl. "F"	1,931 tons	6.50	6.20	6.40
41. Bit. cement-MG-2 prime coat	15 tons	28.00	23.75	25.00
42. Bit. cement RC4 non skid seal	22 tons	30.00	27.50	30.00
43. Min. agg. for non skid seal	153 c. y.	3.50	3.50	4.00
LIGHT BITUMINOUS SURFACE TREATMENT				
44. Cr. stone surf. — top course	60 c. y.	3.50	3.50	4.00
45. Bit. cem.-MC-2	1 ton	20.00	27.50	30.00
46. Prep. of rdy. & spreading & brooming top course	400 s. y.	.40	.05	.15
MISCELLANEOUS ITEMS				
47. Relaying conc. or V. C. pipe 12 in	78 l. f.	.75	.25	.50
48. Relaying conc. or V. C. pipe 18 in	54 l. f.	1.00	.30	.80
49. Drain pipe 8 in	1,000 l. f.	.60	.50	.75
50. Dipped corr. iron pipe 8 in	1,080 l. f.	.85	.90	1.00
51. Conc. or V. C. sewer pipe 8 in	90 l. f.	1.00	.55	.60
52. Conc. or V. C. culvert pipe 12 in	488 l. f.	.85	.75	1.00
53. Std. reinf. conc. culvert pipe 18 in	1,696 l. f.	1.65	1.60	2.00
54. Std. reinf. conc. culvert pipe 24 in	900 l. f.	2.60	2.60	3.00
55. Top soil	5,000 c. y.	1.00	2.00	1.50
56. Reflector button land markers	200 ea.	2.00	1.75	2.50
57. St. reinf	16,000 lb.	.045	.05	.05
58. Clearing	27 acres	150.00	200.00	224.00
59. Grubbing	13 acres	150.00	175.00	200.00

UNIT NO. 7

Contract time, 270 days; two bidders.

LOW BIDDERS:

1. Dally Const. & Engf. Co., Seattle (contract) *$275,195
2. J. H. Pomeroy & Co. Inc. & Parker-Schram & Company, Portland, Ore. 295,258

* Adjusted bid, $169,392.

Item	Quan.	Unit Prices (1)	(2)
1. Struct. excav.	6,120 c. y.	2.75	2.00
2. Conc. cl. "A"	4,590 c. y.	23.00	25.00
3. Conc. cl. "B"	1,246 c. y.	23.00	24.00
4. Reinf.	1,490,000 lb.	.045	.05
5. Cast steel drains	16 ea.	25.00	30.00
6. Reflector units	16 ea.	10.00	12.50
7. Reinf. conc. bridge railing	2,322 l. f.	4.00	4.50
8. 3½-in. Galv. steel pipe	154 l. f.	1.50	2.75
9 Dipped corr. iron pipe 8-in	172 l. f.	1.00	1.00
10. Hand placed riprap	20 c. y.	6.00	7.00
11. Admin. building & toll booths	L. S.	30,716.00	32,500.00
12. Lighting system	L. S.	9,000.00	12,500.00
13. Admin. building & toll booth equipment	Act. cost	7,000.00	7,000.00

UNIT NO. 8

Contract time, 270 days; high bid of seven, $360,792.

LOW BIDDERS:

1. N. Fiorito Inc., Seattle (contract) *$253,151
2. Acme Const. Co., Macri Bros., Seattle 260,017
3. Erickson Pav. Co., Seattle 262,575

* Adjusted bid, $240,393.

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Remov. exist. pavt	7,460 s. y.	.25	.20	.50
2. Select roadway borrow	44,030 c. y.	.75	.70	.80
3. Conc. pavt. 9 in. x 6½ in. x 9 in. — Std. 14 Day Mix	9,270 s. y.	1.65	1.90	1.77
4. Pavt. reinf. type No. 2	34,070 lb.	.045	.06	.05
5. Dowel bars with rubber caps	7,410 ea.	.22	.22	.20
6. Dowel bars without caps	17,630 ea.	.15	.14	.13
7. 8-in. Pl. conc. or V. C. sewer pipe	225 l. f.	.50	.50	.35
8. Gravel backfill	150 c. y.	3.50	3.50	2.30
9. Finishing roadway	141 Stds. (100 ft.)	10.00	10.00	10.00
10. Slope treatment	8,500 l. f.	.08	.10	.10
11. Clearing	43 acres	150.00	200.00	150.00
12. Grubbing	25 acres	150.00	200.00	100.00
13. Excav.-Uncl.-Incl. haul of 600 ft	341,050 c. y.	.23	.21	.23
14. Struct. excav. incl. haul of 600 ft	2,060 c. y.	1.25	.90	2.00
15. Excav.-Cl. "D" haul 600 ft.	1,090 c. y.	1.25	.90	1.50
16. Overhaul on above materials	375,490 c. y. stds.	.01	.01	.005
17. Overhaul on above materials	13,750 c. y. mi.	.12	.10	.09
18. Conc. pavt. 10-in. x 7-in. x 10-in. std. mix	33,245 s. y.	1.75	2.00	1.86
19. Conc. pavt. 10-in. x 7-in. x 10-in. high early str	140 s. y.	1.95	2.20	2.06
20. Conc. pavt. 9-in. x 6½-in. x 9-in. high early str	5,620 s. y.	1.85	2.10	1.97
21. Conc. pavt. br. appr. slabs.-std. 14 day mix.	150 c. y.	10.00	12.00	15.00
22. Hand placed riprap	110 c. y.	8.00	5.00	2.00
23. Cable guard rail	8,110 l. f.	.62	.65	.65
24. Std. guard rail	1,730 l. f.	.75	.50	.75
25. Std. conc. right of way markers	62 ea.	1.50	2.00	1.65
26. Std. conc. gutter	8,710 l. f.	.60	.65	.70
27. Crushed gravel surfacing — top course	280 c. y.	2.00	3.50	3.00
28. Bit. cem. MC-2	3 tons	30.00	30.00	24.00
29. Prep. of rdy. & spreading & brooming top course material	1,200 s. y.	.30	.20	.10
30. Spec. conc. catch basin	2 ea.	50.00	40.00	50.00
31 Spec. conc. inlet	22 ea.	25.00	40.00	35.00
32. Relaying pl. conc. or V. C. pipe 12-in	54 l. f.	.85	.50	.25
33. Relaying pl. conc. or V. C. pipe 18-in	162 l. f.	1.35	.80	.40
34. Dipped corr. iron pipe 8-in	930 l. f.	.85	1.00	1.20
35. Pl. conc. or V. C. culvert pipe 12-in	54 l. f.	.85	1.00	.80
36. Std. reinf. conc. culvert pipe 18-in	1,410 l. f.	1.65	2.00	1.90
37. Std. reinf. conc. culvert pipe 24-in	142 l. f.	2.60	3.00	3.10
38. Conc. crib headers 5-in. x 6-in. x 4 ft	2,192 l. f.	.60	.60	.60
39. Conc. crib headers 5-in. x 6-in. x 6 ft	1,296 l. f.	.60	.60	.68
40. Conc. crib headers 5-in. x 8 in. x 6 ft	348 l. f.	.65	.75	.65
41. Conc. crib stretchers 6-in. x 6-in. x 6 ft	3,540 l. f.	.55	.55	.50
42. Conc. crib stretchers 6-in. x 8-in. x 6 ft	1,548 l. f.	.55	.65	.60
43. Conc. crib pillow blocks 6-in. x 6-in. x 1 ft. 3-in	58 ea.	.50	.40	.50
44. Relaying exist. 1-in. galv. iron water pipe	200 l. f.	.25	.25	.20
45. Relaying exist. 2-in. galv. iron water pipe	600 l. f.	.35	.25	.25
46. Removing guard rail	890 l. f.	.15	.15	.15
47. Resetting guard rail	890 l. f.	.25	.25	.30
48. Pl. conc. or V. C. drain pipe 8-in	230 l. f.	.65	.75	.50
49. Extra str. reinf. conc. pipe 36-in	300 l. f.	6.50	6.50	6.00
50. Galv. iron water pipe 1-in	30 l. f.	.50	.40	.35
51. Galv. iron water pipe 2-in	60 l. f.	.75	.50	.60
52. Std. conc. or brick manhole	1 only	75.00	125.00	100.00

(Units 9, 10, 11, to be published next week)